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WEST INDIAN AGRICULTURE.

Conference of Agricultural Officers.

ON the afternoon of 23rd January, the Hon. S. M. Grier, C.M.G., Acting Governor of Trinidad, opened the West Indian Conference of Agricultural Officers which was held under the Chairmanship of the Principal at the Imperial College of Tropical Agriculture. This Conference which sat for six days was officially attended by the Commissioner and Assistant Commissioner of the College Advisory Department of Agriculture, nine delegates from the several Colonies represented which included British Guiana, Trinidad, Barbados, Bermuda, the Leeward and Windward Islands, seven members of the Professorial Staff of the College, and the Editor-Librarian, who acted as Secretary. His Excellency in welcoming the delegates stressed the importance and potential value of the Conference whose primary objective was to bring together agricultural representatives from the various parts of the West Indies for the purpose of co-ordinating the work which they were doing. Mr. Evans, Principal of the College, prefaced his address by a statement on the origin of the Conference and by two messages of good wishes received from Lord Passfield and Sir Edward Davson, which both emphasised the need for co-operation. The Principal then dwelt at some length on the specific functions of the College and outlined the programme of the Conference. The Hon. J. S. Dash, Director of Agriculture, British Guiana thanked His Excellency for the address of welcome and Mr. Evans for the excellent arrangements that had been made in connection with the organisation of the Conference. On the afternoon of the same day a Garden Party was given in honour of the delegates by Mr. and Mrs. Evans.

On the following day the subject of the Canadian trade in fruit and produce was fully discussed. Mr. J. A. McBride, General Manager of the Fruit Importers Ltd., Canada and Mr. F. E. Holloway, President of the Mutual Brokers, Montreal Ltd., had been invited to join in the discussion and gave much valuable information on the development of this trade in Canada. On 25th January, Mr. F. Hardy, Professor of Chemistry and Soil Science, opened a discussion on "Soil Research" by delivering an address on the development of this line of research in the West Indies. On the following day experimental programmes were discussed and Mr. C. Y. Shephard, Professor of Economics, read a paper on "Agricultural Economics." On 28th January, Mr. E. E. Cheesman, Professor of Botany and Genetics,

introduced the subject of cane variety problems of the West Indian regions. As a result of these papers and discussions a number of findings were framed which will in due course be published in the Proceedings of the Conference. The last day of the Conference was devoted mainly to the consideration of the reports and recommendations submitted by the Sub-Committees. The first of these Sub-Committees was appointed under the Chairmanship of Mr. H. A. Ballou, Commissioner of Agriculture for the West Indies, to examine quarantine rules and regulations, and the second, under the Chairmanship of the Hon. J. S. Dash, to consider the standardisation of the lay-out of field experiments.

As it was not possible, owing to lack of time, for the delegates to submit suggestions for items to be considered at the Imperial Agricultural Research Conference to be held in 1932, it was decided to forward the Secretary of State's letter asking for this information to the delegates for consideration. Other questions discussed were the formation of a Permanent Conference Committee and the date of the next Conference. A very appreciative vote of thanks by the visiting delegates to the Governors and Staff of the College, the Chairman, the Director and Staff of the Trinidad Department of Agriculture and to the Secretary concluded the Proceedings of the Conference.

A number of excursions were arranged. The delegates first visited the Government Stock Farm where they were given the opportunity of discussing problems of cattle breeding in the tropics with Captain H. V. Metivier. On 26th January, which was a Sunday, the Headquarters of the Trinidad Department of Agriculture at St. Clair, were inspected on the way to the Department's Experimental Station at River Estate where, after a most instructive morning, the delegates were the guests at lunch of the Director of Agriculture. A visit was paid to the Cotton Station on 27th January, the party being shown round by Drs. S. C. Harland and E. J. Maskell and Mr. J. B. Hutchinson.

Finally on 28th January, an excursion, arranged through the courtesy of Captain W. F. Watson was made to the Waterloo Estates, where it was possible to inspect the large scale series of lime and fertilizer trials that had been designed on the most up to date lines, with the object of testing out in the field the recommendations made by the Scientific Committee of the Froghopper Investigation Committee. A demonstration of mechanical tillage methods followed and on the way to Exchange House, where the delegates enjoyed the hospitality of Mrs. Watson, a visit was made to the Model Dairy.

On the 25th January all official delegates were entertained to dinner at Government House by His Excellency the Acting Governor and Mrs. S. M. Grier. Another dinner was given in their honour by the College Amalgamated Clubs on 27th January in the College Dining Hall. Both these functions were much appreciated.

FERTILISERS FOR CITRUS TREES.

Experiments in Australia and California.

THE conclusion arrived at by investigators both in California and in Australia is that the element which it is most important to supply to citrus trees is nitrogen. Discussing this subject in a departmental publication, Dr. H. J. Webber, Director of the Citrus Experiment Station, California, states that one experiment with 22 treatments on about ten acres of citrus orchard had been pursued consistently for over 21 years, while another, in an old run-down orchard of 20 acres, was continued for a period of five years, and observations on effects of the treatments continued for eight years. Comparative experiments with growers covering periods of from three to five years or more have been organised and followed in San Diego, San Bernardino, and Tulare counties. As a result of these long-continued and rather extensive experiments, the following preliminary general conclusions have been reached with reference to citrus fertilisation in general in California :—

1. That nitrogen is the limiting element, and must usually be applied in large quantities, varying from 1½ to 3 lb. of actual nitrogen per bearing tree.

2. That liberal quantities of organic matter in most instances must be applied either through the application of organic manure, alfalfa hay, bean straw, or some similar material.

3. That phosphoric acid and potash, ordinarily considered as necessary constituents of all complete fertilisers, do not give appreciable crop increases on many citrus soils.

Commenting on the foregoing, a fruit branch officer of the New South Wales Department, who is specially concerned with citrus crops, states that results of a number of experiments on departmentally controlled plots and observations of private growers' practices in coastal and also in inland areas offer confirmation of the Californian recommendations. The practice of using increased amounts of nitrogen, in quantity according to the age of the tree is not yet as widely followed as is desirable. In some cases growers are purchasing a limited amount of fertiliser for use on an area of trees far too great. In such cases production is already low, and it is scarcely improved by such parsimonious applications ; it would be preferable to apply the amount to a greatly reduced number of trees so that each gets sufficient. The benefit of this would become apparent in most cases, and would result in the purchase of a greater quantity of the fertiliser. The type of fertiliser seems of the greatest importance. Much prejudice exists against inorganic fertilisers, and trials by growers on their own orchards are very rare, but those growers who are providing their trees with organic matter in the form of green crops or other matter supplemented by inorganic nitrogen (sulphate of ammonia, nitrate of soda, &c.), according to the demand of the trees, are undoubtedly producing citrus fruit most economically.—(*The Fertiliser, Feeding Stuffs and Farm Supplies Journal*, Vol. XIV, No. 25.)

JAVA AND ITS SUGAR INDUSTRY.

By W. Scott, B.Sc.,
Professor of Sugar Technology.

Java lies between 6° and 8° South of the Equator; and is from both economic and political points of view the most important unit of the Netherlands East Indies. As to size, however, it is the smallest of the Greater Sunda Group which includes, besides Java and Madoera, Sumatra, Borneo and the Celebes. In addition to the Greater Sunda Islands, Dutch possessions in the East Indies include the Lesser Sunda Islands which extend from Bali to Timor, and also the western part of New Guinea. The total area of the Netherlands East Indies is 733,680 square miles. Java with Madoera covers an area of 50,762 square miles or slightly less than England without Wales. The importance of Java as compared with the other Dutch possessions in the East Indies is emphasized by the official division of the Dutch Archipelago into two groups:—

1. Java and Madoera.
2. The "Outer Possessions."

Population.

The population of Java and Madoera is estimated at about 38 millions, or more than 750 to the square mile. It has increased by over 10 per cent. since 1920. The population of the "Outer Possessions" is about 15 millions.

Europeans in Java number slightly over 150,000, the majority of whom are Dutch or of Dutch extraction. The foreign Oriental population exceeds half a million and includes a considerable proportion of Chinese. The latter are usually prosperous and form a powerful economic unit.

The native population of Java belongs to the Malay stock, and can be roughly divided into three groups which speak distinct languages:

(1) The Sundanese in West Java.
(2) The Javanese in Mid and East Java.
(3) The Madurese in East Java and Madura.

The original types have been somewhat modified through influx of foreign blood from early times—Hindus at first, then Arabs. Chinese have throughout the centuries settled in Java, intermarrying with the native population, but have made no bid for political power.

Islam was introduced into Java about the 13th century, displacing Hinduism within two centuries. Nearly the whole native population to-day, professes the Mohammedan faith.

There are few large cities in Java, the great majority of the natives live in villages and belong to the farming class. In the villages or *desas*, they are controlled by their own elected chiefs, or headmen, the Dutch civil service merely supervising the native government. Although the civil, commercial and criminal codes for Europeans and foreign Orientals are practically identical with those in force in Holland; the natives are usually ruled according to their "Adat," or native law, which is simpler and less expensive. Education in elementary schools in the villages is in one of the vernaculars which are all more or less akin to Malay. In some of the higher schools instruction is in Dutch. Malay is usually employed by Europeans in Java, and throughout the Archipelago, in conversing with the natives.

Climate.

The climate of Java is influenced by two main factors:

(*a*) Altitude.
(*b*) The Monsoons.

(*a*) The highlands are characterized by abundant rainfall and low temperatures. Notwithstanding the proximity of Java to the Equator, it is not unusual to experience freezing temperatures on the higher mountains.

(*b*) The hills and lowlands are principally influenced by the Monsoons. The periods of heaviest rainfall in those sections corresponds with the West Monsoon between November and February, while the dry season occurs during the South-East Monsoon from May to August. Owing to the very slight degree of variation in atmospheric pressure there is a general absence of strong winds. The average rainfall is about 80 inches with variations ranging from 55 to 120 inches.

Soil.

Java lies on beds of ancient igneous or crystalline limestone rocks which are broken in various places by more than a hundred volcanoes of comparatively recent origin. As a result, and owing to the abundant rainfall at the higher altitudes, the greater portion of the soil in the plains—especially near water-courses consists of young volcanic material washed down from the mountain tops and is very fertile. The rest of the soil of the island consists of alluvial and tertiary lime and chalk formation and does not compare in fertility with the volcanic soil.

Agriculture and Systems of Land tenure.

Favoured as it is by diversity of climate, a fertile soil, and abundant supply of cheap labour, Java produces a greater variety of crops than any other country within the tropics.

Agriculture is divided into two groups: Estate and Native. Estate produce is as a rule grown exclusively for export; while the principal object of native agriculture is to supply food for the inhabitants. Incidentally native agriculture is an important contributor to the export trade. Agricultural practice, at least in the case of certain crops, is somewhat influenced by the laws governing the tenure of land. Non-indigenous residents are forbidden to purchase land from natives but can obtain it in one of four ways, the Government taking care that the interests of the natives, both present and future, are safeguarded. The four systems of land tenure are as follows:—

(1) Leasehold for a maximum period of 75 years.
(2) Lands rented voluntarily from the native population.

(3) Lands hired from the native Princes.
(4) Private lands, which were purchased outright under the regime of the East India Company and during Raffles' administration.

The last two systems are not encouraged. In fact private lands are purchased by the Government whenever the opportunity arises; and in cases where they are planted in estate produce, they are usually returned to the late owners on lease. The maximum period for which land can be rented from the natives is 21 years; there must, however, be periodical interruptions during which the natives regain possession of the land for their own agricultural purposes.

With the exception of a few plantations on private property or on leased ground, sugar-cane is grown on lands rented from the native population.

Agricultural Products of Java.

Native Cultivation.	*Estate Cultivation.*	*Common to both Systems of Cultivation.*
Rice (Irrigated and non-irrigated).	Rubber.	Tobacco.
Maize.	Sugar.	Kapok.
Ground Nuts.	Coffee.	Coconuts.
Soya Beans.	Tea.	Tapioca. (Cassava).
Sweet Potatoes.	Cinchona.	Pepper.
Other vegetable food crops.	Sisal.	
	Cocoa.	

Teak forests are owned, developed and exploited by the State.

Owing to the fact that there are practically no further areas to be brought under cultivation, both the Government and Private Estates have recourse to scientific research to increase yields on the planted areas. The Government's activities are principally directed towards improvement of native agriculture and the development of irrigation systems. That those efforts are eminently successful may be gathered from the fact, that in 1927, for instance, Java produced 7,265,000 metric tons of rice or 97½ per cent. of its total requirements. The average yield of rice per acre is stated to be more than double the yield obtained in British India.

The activities of the State in promoting and encouraging native agriculture may be summed up as follows:—

1. Study of plant diseases by Research Staff and dissemination, through specially trained inspectors, of information regarding methods of combating pests and diseases.
2. Distribution of seeds from high yielding varieties for the various native crops.
3. Construction of new irrigation works and improvement and co-ordination of the native systems of irrigation.
4. Provision of adequate transport facilities through construction of roads and railways.
5. Establishment of agricultural credit banks advancing money at moderate rates of interest.
6. Development of elementary schools in villages where, besides acquiring a rudimentary knowledge of reading, writing and figures the native learns something about improved methods of agriculture.

The various industries grouped under Estate Agriculture maintain their own research organizations.

The Sugar Industry.

The most advanced and scientifically conducted industry in Java is the Sugar Industry. It is probably one of the most thoroughly organized industries of its kind in the world and, at first glance, one cannot help wondering at the number of different "Associations" which form its structure. On closer acquaintance, however, with conditions under which sugar is produced in Java the necessity for this elaborate structure becomes more apparent.

Organizations.—The most prominent organization is, of course, the "General Syndicate of Sugar Manufacturers in the Netherlands Indies" with headquarters in Soerabaya. Nearly all sugar estates in Java are members of the "Sugar Syndicate"; they each contribute one and a half guilders per "bouw" equivalent to 1*s.* 5*d.* per acre of land under cane cultivation towards its maintenance. The "Sugar Syndicate" is looked upon as the "watch-dog" of the industry. It deals with all problems relating to land, irrigation, transport, &c.; and interests itself particularly in all pending legislation which may effect the industry. Its "Daily Board of Control" acts as an advisory committee to the Government.

The "Proefstation" at Pasoeroean is the property of the Society "Experiment Station of the Java Sugar Industry" which, itself, is a sub-organization of the Sugar Syndicate. The famous institution, which is by far the best equipped research station in the tropics, is supported by means of a levy of five guilders per "bouw" equivalent to 4*s.* 9*d.* per acre under cane cultivation. Practically every sugar estate in Java contributes to this fund which now amounts to about £120,000 per annum.

Another organization closely related to the Sugar Syndicate is the "Java Sugar Employers' Association" which includes in its membership about 90 per cent. of the sugar producers. This association deals entirely with labour problems and is presided over by the Chairman of the Sugar Syndicate.

The "United Java Sugar Producers" (V.S.P.) is really a central co-operative sales agency for the sugar industry and operates on a non-profit making basis. The V.S.P. is entrusted with the sale of 90 per cent. of the sugar produced in Java. It collects the proceeds and distributes them according to quality and quantity of sugar received from each producer.

In Holland is to be found the headquarters of the "Association of Sugar Factory Owners in the Dutch East Indies" (B.E.N.I.S.O.).

JAVA AND ITS SUGAR INDUSTRY.

(*See page 59.*)

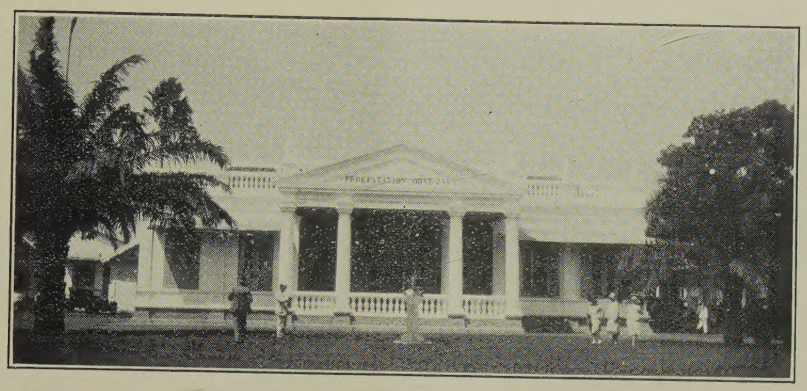

FIG. 1.—*Central Building of the Experiment Station, Pasoeroean.*

FIG. 2.—*Irrigated Rice Terraces*

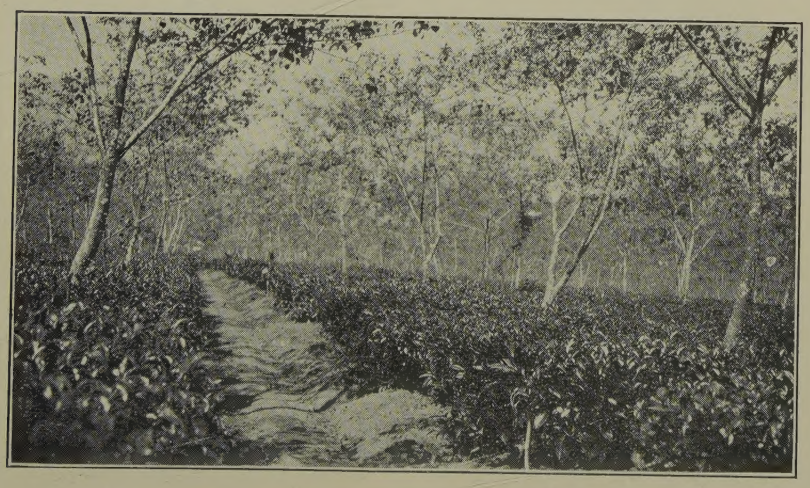

FIG. 3.—*A Tea Plantation at 5,000 feet elevation.*

JAVA AND ITS SUGAR INDUSTRY.

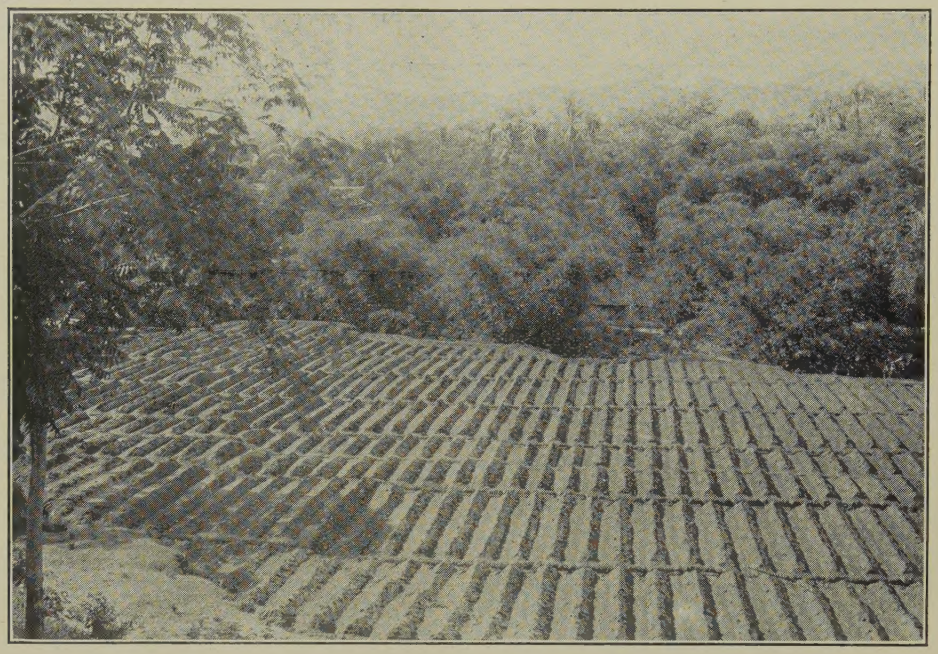

FIG. 4.—*A cane "garden" laid out according to the Reynoso system.*

FIG. 5.—*A Nursery. The tops have already been used for planting; the sprouted eyes will provide "rajeongan" seed.*

Finally, the "Sugar Union" is an organization of Europeans in Java employed in the sugar or allied industries. It is, of course, not a "Trade Union" in the generally accepted sense of the term.

One might well wonder how co-operation in every single phase affecting the industry could have been so successfully established on such a huge scale. Apart from the peculiar genius of the Dutch for organisation, the principal reason is to be found in the fact that the majority of factories in Java belong to, or are controlled by, powerful financial groups with the broad outlook necessary for effective co-operation. Individually owned factories have only gradually availed themselves of the benefits of co-operative action; but to-day nearly all the "Associations" include in their memberships at least 90 per cent. of the sugar producers of Java.

Pasoeroean.—The "Proefstation" or Experiment Station is located at Pasoeroean in East Java. It performs numerous functions; and its influence is felt throughout the sugar industry of Java. The staff employed by the station numbers about 60 Europeans and 250 natives. There are three departments: the Agricultural, the Technological, and the Engineering departments each with its own director; the three directors form a board entrusted with the scientific management of the station. Investigations of cane diseases are carried out by a sub-station located at Cheribon; it is proposed, however, to transfer this work to Pasoereoan in the near future. Space does not allow of going into details of the many activities of each department; only a few salient features can be mentioned here.

The Agricultural department undertakes research work at the station; and also maintains a special extension service which acts as a connecting link between the station and the factories. For purposes of the latter service Java is divided into fifteen agricultural districts, each supervised by an officer appointed by the station and resident in the district. Each officer studies conditions affecting yields of cane in his districts, supervises all variety and manurial experimental plots on the various estates, and advises the field staff of each estate. The districts are also visited regularly by two senior Agricultural Officers with headquarters at Pasoeroean. In the research field the activities of the department cover a wide range. Cane breeding for resistance to disease is one of its most important functions. The crossing of canes for definite characteristics has attained a high state of development in Java. Local conditions lend themselves admirably to this work since, by growing the cane at various altitudes, the period of tasselling of varieties as well as the fertility of the parent canes can be nicely controlled. Among other important work of the department may be mentioned: a chemical survey of all sugar-cane soils; also the mapping of the immediate subsoils by observing the occurrence of particular weeds. Large scale experiments on lime requirements have also been started recently as many of the soils have an acid reaction.

The Technological department attends to all problems arising out of the manufacture of sugar or its chemical control. It also compiles fortnightly the factory control figures for all factories contributing towards the maintenance of the station. It arbitrates between buyers and sellers of raw sugar. In addition to applied research a certain amount of fundamental research is done by the chemical section of this department.

The Engineering department attends to problems of fuel economy and economical use of power. It undertakes tests of machinery and is often called upon in a consulting capacity. It has developed useful new devices which are used in increasing numbers in Java factories.

The combined activities of the various departments of the Experiment Station save personnel, equipment and money to individual estates.

Methods of Cultivation.—Sugar-Cane Cultivation in Java belongs to the class of Estate Agriculture. Small quantities of cane grown by natives are crushed in crude mills driven by animal power; this native industry, however, is a negligible factor. During recent years there has been a certain amount of political agitation for inclusion of the sugar-cane among crops cultivated by the natives. This proposal has been strongly opposed by the industry principally on the ground that control of pests and diseases would become very difficult if not impossible. There are therefore, so far, no "Cane Farmers" in Java.

The land used for cane cultivation is usually rented from the natives; the price paid varies, more or less, between £3 and £5 per acre per annum. Owing to the fact that such land is allowed to bear only one crop of cane in three years, the cane lands adjacent to a factory must be divided into three sections one of which is planted in cane each year. The other two sections, in the meantime, are planted in rice or other native crops by the owners.

Naturally only the best lands are selected for cane cultivation. Such lands represent less than 10 per cent. of the irrigated lands of Java. It has been estimated that a cane crop requires about one-fourth of the irrigation water necessary to produce a rice crop. Yet the cost of irrigation works in a sugar-district is largely borne by the sugar interests.

Preparation of Land.—Land is prepared for sugar-cane cultivation by one of two methods: ploughing, or the "Reynoso" system. The former is the older method, but it has been gradually replaced by the "Reynoso" system in such soils that are not of too loose a texture. The "Reynoso" system involves hand labour throughout, is somewhat more expensive but yields more cane. Where ploughing is practised the field is ploughed with native or European ploughs or both, from four to six times, and then furrowed for planting. In the "Reynoso" system the land is taken over soon after the rice

has been harvested and all preliminary operations are carried out with a spade while the fields are in a semi-flooded condition. This condition for working the land seems to appeal particularly to the Javanese labour, so used are they to working in irrigated rice fields. The preparation of the field consists in providing:

(*a*) A drain around the field as well as transverse drains.

(*b*) Ditches, which are used both as water-courses and drains.

(*c*) Planting trenches.

The planting trenches are at right angles to the watercourses; the distance between the latter varies with the nature of the soil, the average being about thirty-two feet. The depth of the trench depends on whether the soil at the bottom is loosened or not: while the distance from centre to centre of the trenches may be from 36 inches to 48 inches. The ridges between consecutive trenches receive no treatment whatever; the loose soil removed from the trenches is placed on top of the ridges and is gradually returned to the cane during the growing period. The watercourses are made several inches deeper than the planting trenches in order that they may act as drains when not utilized for irrigation.

It is as a rule necessary to allow several weeks to elapse between the preparation of a field by the "Reynoso" system and the actual planting so that the soil may be sufficiently drained and aerated.

Planting.—Planting is done between April and July. Owing to the fact that the crop season does not begin until May or June, nurseries supply the early planting material. Previous to the advent of P.O.J. 2878, all seed cane had to be first obtained from hill-farms, because the "Sereh" disease does not occur at high elevations. Those cuttings were propagated in plains-nurseries which in turn provided material for planting the whole estate. P.O.J. 2878 being resistant to "Sereh" the hill-farms have lost their importance and nurseries are now established on the estates themselves.

The cane seed ("bibit") may be one of the following:

1. The Cane-top.
2. A two-eye cutting or
3. "Rajoengan" seed, which consists of sprouted eyes about a foot in length.

"Rajoengans" are obtained in the following manner: cane-tops from the nursery are cut off and used as the first available planting material, the stalks being left standing. After the eyes have sprouted they are gradually cut off (two "rajoengans" per seed) and used as planting material. The leaves of the "rajoengans" are trimmed down to about half their original length.

The seed (usually two eyes) is planted at the bottom of the trench either in the loosened soil or loose soil is placed upon it, the space between seeds being about 18 inches from centre to centre. The first application of Sulphate of Ammonia takes place about two weeks later—all fertilizer being applied within 60 days of planting. Until the cane reaches a height of about two feet irrigation is done by hand (by the splash method); afterwards the trenches are opened to the drains and irrigation is done by flooding. Hilling up with the loose soil from the ridges is done from time to time until, at maturity, the cane stools stand on a very slight ridge. With this system the cane stands perfectly erect to a height of 15 feet or more. Weeding is done by women and children. As the cane crop follows immediately after rice and the cane grows very rapidly, little weeding is necessary.

Most of the field operations described are carried out on the contract system.

Harvesting—The cane in Java reaches maturity and is reaped within 13 to 14 months of planting. The degree of maturity of each field is carefully determined on most of the estates in the following manner: once a week, for several weeks preceding the probable date of reaping, samples of cane tagged by the agriculturist in the field are brought to the laboratory where the canes are cut in three equal sections, which are separately analysed. A curve is plotted out of the calculated weekly yield from each section of the cane. When the curves for the middle and the lower sections are as close to each other as past experience has shown to be likely the field is passed as mature.

The method of harvesting cane is an interesting one. The whole stool is pulled out of the ground, or dug out with a crowbar, the topping and cutting of the cane being done subsequently. Contracts are let out to groups of two or three men, one of whom dig the stools then tops, cuts and cleans the cane. The others tie the canes in bundles which they load in portable track railway cars or into bullock carts. They must also pile up the trash in the middle of the furrow. Three men cut and load about five tons per day earning on an average about 1*s.* 3*d.* each.

The cane trash is either transported to the factory to be used as fuel or is burned in the fields. The cane is never burned before cutting; special precautions are in fact taken against accidental fires by removing trash from the fields for a distance of about 30 feet from the road.

Transport of cane to the factory is sometimes effected by bullock carts. The general method of transport is by means of narrow-gauge railways, the loaded cars being drawn either by bullocks or locomotives. Factories, as a rule, own no cattle with the exception of some pure bred stock kept purely for improving the native stock. Bullocks for field work or transport are hired from the natives. As most of the field work is done by contract, the latter often includes the hire of the labourer and his team of bullocks or "carabaos." Labourers engaged in the cultivation and harvest of sugar-cane live in their own villages. Housing accommodation is provided by the sugar companies only for their European staff and the skilled factory labour.

Factories.—The laws governing the tenure of land do not encourage the erection of factories of very large capacity. The largest factory in Java (Djatiroto) has a grinding capacity of

5,000 tons of cane per 24 hours. The land controlled by this estate is held on a 75-year lease; it is permissible, in this case, to grow two crops of cane on the same land within a three-year period. The next largest factory does not exceed a capacity of 3,000 tons cane per 24 hours. The daily rate of grinding of the larger factories ranges between 2,000 and 3,000 tons. The factories of Java are of the low-level type, the machinery is all on the ground level or on stagings. They cover more ground space and have a larger number of pumps than the gravity-type factories.

The milling practice differs somewhat from that of other countries. Few preparatory devices such as cane-knives or shredders are used. The long straight canes lying in parallel layers on the cane-carriers do not lend themselves readily to preparation by knives. For the same reason Krajewski crushers are used exclusively. Most mill rollers carry only shallow grooving and, owing to the very heavy pressures applied to the top rollers, feeding rollers or other similar devices are largely used. The latest tendency seems to be towards reduction of mere brute force and more extensive lixiviation of the bagasse with hot water and juice. Several factories have, for instance, adopted the hot maceration system of Nobel. Further extension of this system will undoubtedly focus attention on preparatory devices of the shredder type, and on deep drainage grooves. The general standard of boiling house methods and chemical control is a very high one. The factories are also models of cleanliness.

Much of the sugar produced is for direct consumption. In 1928 about 65 per cent. of the sugar produced by the Associated Mills consisted of white plantation sugars made either by the carbonatation or the sulphitation process. It is now generally agreed that sugars made by the carbonatation process are of somewhat higher quality than plantation whites made by sulphitation; but the various types of sugar made meet the requirements of their respective markets The principal markets of Java for sugar are: British India, China, Japan, Europe and the Straits Settlements. The local consumption is estimated at 300,000 tons or only 18 lb. per head of population.

The total sugar produced in Java in 1928 amounted to 2,939,000 tons showing an increase of 24.5 per cent. over the production of 1927 which was 2,360,000 tons. The acreage under cane cultivation in 1928 was only five per cent. larger than in 1927. The net increase in production is credited to the variety P.O.J. 2878 which gave higher yields, both in the field and factory, than any other variety so far grown in Java. This cane variety, alone, has more than repaid the Java Sugar Industry for all sums spent since the inception of the Experiment Station. P.O.J. 2878 has attracted a great deal of attention throughout the sugar world, and can now be found in the variety experimental plots of most tropical cane producing areas. In some countries it is already cultivated on a fairly large scale. It will be interesting to learn something of its ratooning qualities.

Conclusion.

General conditions in Java have had a marked influence on many of the methods used throughout the sugar industry. Conditions that were favourable to sugar production have been admirably utilized; the industry, on the other hand, has adapted itself remarkably well to other conditions which could have been regarded as serious handicaps. Co-operation, organization and unstinted support of scientific research have overcome most obstacles and contributed largely towards building up the industry to its present position.

The writer is greatly indebted to his genial hosts at the Sugar Congress of 1929 for much valuable information concerning conditions and methods of sugar production in Java.

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CACAO FERMENTATION.

THE Year Book of the Gold Coast Department of Agriculture for 1928 which has just been published, contains some interesting papers by R. H. Bunting, H. A. Dade and J. L. Scott which elucidate the causes of defective cacao production in the Gold Coast.

Mr. Bunting in Paper VII has attempted to correlate the various defects which occur in samples of cured cacao beans with their causes. Defective types discussed are: (1) Under-developed beans (contained in every ripe pod). (2) Immature beans (from immature pods). (3) Germinated beans. (4) Diseased beans. (5) Slatiness. (6) Cheesiness. (7) Discoloration (due to prolonged drying), (8) White Spot (due to excessive evaporation during fermentation), and (9) Mouldiness.

In Paper VIII he describes several species of moulds which he has found to occur in the interior of the beans during different stages of their preparation. As he points out it is necessary for this to be done before the diverse conditions requisite for the needs of the various species of moulds can be studied.

In Paper IX, Mr. Scott shows that fermented beans are hygroscopic, and that their water content varies directly with the humidity of the atmosphere with which the beans are in contact. Although the exact equilibrium may take several days before it is complete, it is attained roughly (within one per cent.) in one or two days. This paper is of great importance when taken into consideration with Paper X by Mr. Dade, who reports that the controlling factor in internal moulding is that of water content. Moulding does not occur if the percentage of water in the beans is less than eight per cent. but is liable to occur if this amount is exceeded. As beans containing eight per cent. of water are in equilibrium with an atmosphere of 82 per cent. humidity, Dade states that it is unsafe to store cacao if the average daily humidity is greater than this.

A. K. B.

GREEN MANURING.

Green Manuring as an aid to the maintenance of Soil Fertility.

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The practice of green manuring had its origin in very early times, for it is a custom which is known to have dated back in various parts of the East for at least 2,000 years. As with certain other sound old customs however, there have been periods when the wisdom of it has been overlooked, and there is no doubt that to-day the practice could be extended far more widely, with great advantage to Empire Agriculture.

The writer can claim to have been the most consistent advocate of green manuring in South and Central Africa. His investigations have extended over the last 20 years, and these notes are contributed to *Tropical Agriculture* principally in the hope that his experiences may be helpful to fellow agriculturists in the tropics and sub-tropics.

Definition of green manuring.

The term 'green manuring' is often very loosely and sometimes wrongly applied. The most correct definition of the process is the turning down of green, unrotted vegetable matter into the soil. This vegetable matter may actually be grown upon the land concerned, or it may be brought from elsewhere. As far as the present article is concerned it is the former method which will be considered, since the latter practice is generally confined to native agriculturists, farming in very densely settled areas.

The expression 'green soiling' is frequently used by the inexperienced, when green manuring is really meant. This term, however, more properly implies cutting a crop green and feeding it in that state to livestock. Similarly 'cover cropping' may be confused with green manuring. The two are not necessarily the same and in order to avoid confusion of terms, it may be said that a cover crop is usually a minor or secondary crop planted under a major one with the object of (*a*) making more profitable use of the land; (*b*) checking soil erosion; (*c*) improving the soil; (*d*) providing at a later date, material to be utilised as a green manure.

In its literal sense green manuring would embrace the ploughing under of all or any green plant material including grass or weeds, but as generally used, the expression infers that the crop has been specially planted for the purpose, or at least is not the result of a normal occurrence such as the growth of weeds. The crop need not, however, have been grown solely with the object of green manuring, for earlier growths may be harvested or grazed off on the land and only the final growth turned under.

The word 'green' must likewise be regarded as comparative, for in some instances—although usually desirable — unavoidable circumstances may cause the plant growth to be almost dry before being turned in.

Objects and advantages of green manuring.

These may be summarised briefly as follows:—

1. Vegetable matter when decomposed in the soil is converted into humus.

2. Humus possesses several important properties. It is capable of absorbing large quantities of water (and with the water, mineral plant foods) without giving this up rapidly through drainage, or evaporation due to capillary attraction. A soil well supplied with humus is less adversely affected by droughts or excessive rainfall, than one poorly supplied.

3. Humus improves the physical character of the land and thereby the tilth. It renders heavy compact soils more porous and friable, and converts light sandy soils into something more nearly approaching a loam.

4. It is the principal reservoir of nitrogen in the soil, and unless it is present in sufficient quantity the multiplication and activity of the most beneficial micro-organisms of the soil are seriously restricted. Utilising this organic matter in the fixation of nitrogen, the carbon dioxide so liberated assists in making the mineral plant foods of the soil more freely available.

5. The maintenance of an adequate supply of humus in the soil is therefore a matter of major importance. Carefully planned investigations in Southern Rhodesia, supported by the testimony of many leading farmers and planters, indicate that in the absence of a sufficiency of humus, artificial fertilisers are powerless to exert their best and most remunerative effect. Indeed, in the Colony referred to it is now widely recognised that the application of fertilisers to a soil deficient in organic matter is mere waste of time and money.

6. Green manuring achieves other essentially practical objects. If suitable varieties are chosen the green manure crop can also be rendered a cleaning crop by reason of its rapid growth and dense shade smothering out the weeds. This is particularly true of certain of the *Crotolarias*. Green manuring and/or cover cropping can therefore be utilised to effect a saving in the labour bill by keeping the fields or plantations more free from weeds.

7. Green manuring, and/or the growing of cover crops under the major crop, protects the land from erosion, that most insidious and inveterate enemy of the tropical and sub-tropical farmer.

8. Deep-rooting leguminous crops are those commonly selected for green manuring. The decomposition of the roots of such plants when ploughed under, raises to the surface soil readily available supplies of plant food recovered from the sub-soil, and otherwise unavailable to surface feeding roots.

9. The same deep-rooting crops perform the office of sub-soiling the land, thereby creating better aeration, drainage and absorption, and better root penetration of subsequent crops.

10. Finally, and most important, green manuring, by the choice of suitable legumes, can be employed to add appreciable supplies of nitrogen to the soil. Those legumes which on the land in question, are able to develop a considerable growth of nodules on their roots may absorb as much as two-thirds of their total nitrogen content from the air. Crops of Sunn hemp (*Crotolaria juncea*) and velvet beans (*Stizolobium spp.*), grown in Rhodesia and yielding approximately from 6½ to 10 tons of green fodder per acre, have been found to contain upwards of 150-200 lb. of nitrogen, some two-thirds of which had probably been collected from the air through the activity of the organisms present in the root-nodules. While it is true that the availability of this nitrogen is somewhat limited, if the figures for temperate climates can be accepted, the limitation is not very serious, and taking the availability of nitrate of soda at 100, that of green manure crops has been placed at sixty-five.

At the Central Experiment Farm, Ottawa, Canada, the ploughing under of red clover for nine consecutive years was found to have increased the nitrogen content of the soil by 472 lb. per acre, while judged on results at the New Jersey Experiment Station, it has been estimated that certain legumes grown there, took from the air and added to the soil no less than 54 lb. of nitrogen per acre per annum.

The above are sufficient indications of the extent to which green manuring and/or cover cropping can be utilised as an inexpensive means of supplying nitrogen to the soil.

Practical results of green manuring.

The so-called practical man—be he farmer or planter—is often disposed to discount what he regards as the theory of the scientist until convinced by an irrefutable demonstration. To those who fall under this category, the following record of an experiment carried out on the Salisbury Experiment Station, Southern Rhodesia, may afford convincing grounds for a greater interest in this subject.

As a preliminary, it may be stated that the Rhodesian maize grower frequently has anything from 400-800 acres under this crop and that for reasons too lengthy to explain here, he is unable to practice any extensive system of crop rotation or to lay his land down to temporary pasture as a means of restoring to it some measure of fertility. Moreover the maximum quantities of animal manure which can be produced on the average farm are relatively so small, compared with the acreage of land annually under crop, as to be of little consequence.

The experiment referred to has been in progress since 1919 and compares the unsatisfactory system of growing maize continuously, year in and year out on the same land, with an alternative system—by no means an ideal one—in which three successive crops of maize are grown, one of which receives an application of 150 lb. of phosphatic fertiliser per acre, while every fourth year the field is green manured by means of a crop of velvet beans ploughed under.

The actual returns from the green manured and fertilised sections have been as follows:—

Yield in Bags (203 lb.) of Maize per Acre.

	1919-20.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.
Section No. 1	23.1*	25.9	G.M.	18.8	11.5*	6.65	G.M.	17.90	14.50*	8.75
Do. 2	23.0	24.6*	11.7	G.M.	13.0	19.85*	13.8	G.M.	14.70	9.0 *
Do. 3	G.M.	28.7	12.7*	17.4	G.M.	15.65	15.8*	14.2	G.M.	17.5
Do. 4	19.2	G.M.	14.5	21.1*	9.6	G.M.	20.2	14.7*	7.8	G.M.

An asterisk indicates the application of 150 lb. of phosphatic fertiliser that year.

It will be noted that at the commencement of the experiment the land was in a very high state of fertility, and that the treatment accorded it has not been sufficiently generous to maintain this high standard of productivity. Extensions of these experiments have recently proved, however, that given the same green manuring and a rather heavier dressing of phosphatic fertiliser *every second* year, the original fertility will be well maintained.

The average yields per acre from the control section planted continuously to maize without recourse to fertiliser or green manure were:—

1919-20, 23.3 bags; 1920-21, 24.2 bags; 1921-22, 11.75 bags; 1922-23, 13.1 bags; 1923-24, 8.4 bags; 1924-25, 7.8 bags; 1925-26, 14.0 bags; 1926-27, 9.63 bags; 1927-28, 4.8 bags; 1928-29, 6.1 bags.

Phosphatic fertiliser—phosphates being the principal mineral plant food deficient in Rhodesian soils—is applied to the second maize crop following the green manuring, yet in spite of this, the yield from the maize immediately following the green manuring has in five years out of nine been greater than the return from the *fertilised maize* two years removed from the green manure crop, and further, the lowest yields of any in the series each year have been given without exception by the maize furthest away from the green manuring.

The farming community of Southern Rhodesia has come to realise very fully the importance of green manuring their extensive maize lands once every four years, as a means of supplying nitrogen and replacing the stores of humus, which in this Colony seem so rapidly to be dissipated. A questionnaire was recently addressed to a number

of leading growers who were asked to state what increase in production they thought would be achieved by working average maize lands on a four-course system consisting of green manure crop, maize with phosphatic fertiliser, maize, and maize with phosphatic fertiliser, the fertiliser dressing being in each case at the rate of about 200 lb. per acre. The concensus of opinion was, that the general adoption of such a system of land management would increase the average crop in the maize belt, by anything from 75 to 150 per cent.

The difficulty which the Rhodesian grower experiences when asked to put such a system into practise is the initial loss of revenue during the first two years. At present, with an average yield of 18 to 21 bushels per acre, the nett profit per bushel or per bag is small. For this reason considerable courage is needed to sacrifice a fourth or a fifth of the year's nett income for two seasons, in order to reap a better return later on. Every progressive farmer, however, is now convinced that had he started this system of green manuring earlier, his fields would not have become as impoverished as they are to-day.

At a recent meeting of the Maize Association of Southern Rhodesia—a body representing more than 1,000 maize farmers—a resolution was carried to the effect that it was unnecessary for the Government further to demonstrate the advantages of a regular system of green manuring, since every maize producer in the country had now become firmly convinced of this, and their only difficulty lay in each year throwing one quarter of their arable land out of a cash crop and into a green manure, even though sure of the ultimately larger profits they would reap thereby.

In this connection it should be explained that save under irrigation, dry-land crops can only be grown in Southern Rhodesia during the five to six months of the rainy season, and to effect a complete green manuring, the land must be given up for a whole growing season to the crop planted for ploughing under. This is not a difficulty experienced in those countries which enjoy an all-the-year or two-season rainfall, nor does it confront planters of perennial crops such as coffee, tea, rubber and so forth.

Already green manuring is adopted largely by tea and rubber planters. In Natal it is gaining in popularity amongst sugar planters. In Rhodesia it has been proved highly profitable even with an annual crop such as maize. Surely there are very few crops or forms of farming or planting in the tropics and sub-tropics of the Empire, to which the system could not be applied with great advantage and at very little cost.

Green manuring and soil erosion.

Soil erosion is a most serious problem in many parts of the Empire, especially in those lying within the zones subject to torrential tropical rains, and in hilly or mountainous countries. Protection of the land from erosion should be regarded as a first and essential step before bringing it under cultivation. This is an ideal, however, which for economic reasons can seldom be realised and usually a country suffers immense injury from this cause before its agriculturally engaged inhabitants realise the enormous damage which soil erosion is annually causing.

Various preventative measures are adopted, such as storm-water drains to cut off the flow of water from higher surrounding land on to the area under cultivation, contour ridges to check the rate of flow of storm water across the cultivated lands, the planting of belts of shelter or shade trees across the slope of the land to serve a similar purpose, and so forth. Further elaboration of this subject would be out of place in the present article, but the point which it is desired to make, is that green manuring will be of little benefit unless accompanied by adequate measures to control soil erosion. For if not, the improvement in fertility effected by green manuring, will quickly be neutralised by the washing away of the improved surface soil. These remarks apply in particular to where annual green manure crops are employed. The biennial or perennial green manure and cover crop can itself be rendered a potent factor in checking erosion.

Continuation of effects of green manuring.

In Southern Rhodesia the effects of one good green manuring have repeatedly been proved to extend over a period of three and sometimes five years, and it is for this reason that local farming custom is coming to adopt a green manuring every fourth year, while in between, three consecutive graminious crops may be grown. In this connection it may be of interest to record that for purposes of farm cost accounting on one of the Rhodesian Government farms it has recently been decided to debit the cost of green manuring as follows:—50 per cent. to the first crop following, 35 per cent. to the second crop and 15 per cent. to the third.

Amongst wheat growers, whose crops are raised under irrigation during the dry season, green manuring with an annual legume each rains, until the wheat straw tends to become over-rank and weak, is gaining support.

Thus far in Rhodesia no instance of green manuring having caused toxicity of the soil—even though repeated every second year, and in the case of citrus orchards every year—has come to the writer's notice.

Reliability of green manuring.

Other writers on this subject have drawn attention to the uncertainty in different countries of the effect of green manuring. In those cases where the process fails to give good results it is believed that an analysis of the conditions will usually reveal the reason. For instance in this Colony it is invariably found that a second ploughing two or three months after the turning in of the green manure is essential if the best response is to be given by the succeeding maize crop planted the following rainy season. Similarly

a drilled crop which receives several cultivations during its period of growth, responds better to green manuring than an uncultivated one—the reasons in both cases being no doubt that the second ploughing and the cultivations help to distribute the humus thoroughly throughout the soil.

There is also a distinct difference noticeable in the potency of different green manure crops, even though all are legumes, and this potency does not seem to rest entirely upon the plant's capacity to produce root nodules freely nor in the bulk of green material which it yields per acre. This suggests a field of enquiry in those instances where green manuring has given disappointing results.

Finally, and as already suggested elsewhere, green manuring, if it is to yield maximum profits, must be accompanied by the adequate addition of those mineral plant foods which analysis of the soil supported by actual field trials, has shewn to be necessary.

Green manuring in zones of low rainfall.

It is frequently stated that green manuring should not be resorted to in areas experiencing a rainfall of much less than 20 inches. Generalizations of this kind are dangerous, for very much depends on the incidence of the rainfall and the conditions under which the major or subsequent crops are grown.

Experience gained on the Government Experiment Stations in this Colony, supported by the weight of evidence of the most progressive farmers, is that crops following a green manuring better withstand the adverse conditions of an exceptionally wet or of an exceptionally dry season, than do the same crops, on adjoining land which has not been green manured. A further point of interest which demonstrates the increased moisture holding capacity of a soil well supplied with humus, is the fact that in this country, at the close of the rainy season or if a drought occurs towards the close, maize plants following a green manuring remain green and vigorous two to three weeks longer than do similar plants on adjoining fields not green manured for several years.

The essence of the problem seems to lie in the fact that turning under of large amounts of undecomposed vegetable matter leaves the soil in a very open condition and makes it liable to suffer severe losses by evaporation. To some extent this can be overcome by rolling and compacting the surface, but the safest course is to turn under the material while it is still green and succulent; while the temperature is still fairly high (to promote rapid decomposition), and when further rains can be expected, as opposed to during a severe drought or at the conclusion of a rainy season.

Rate of decomposition.

This depends primarily on the three factors just referred to, but different crops—depending on their characteristics—vary in their rate of decomposition. Given a succulent and not too woody growth, a reasonably high temperature and a fair amount of soil moisture, decomposition should be well advanced within four to eight weeks of ploughing under. When such conditions have prevailed and where required, it is usually safe to replant the land to a second crop within four weeks of the green manuring. In the Umtali district of Southern Rhodesia, it is becoming a practice to sow the green manure crop, Sunn hemp, with the first rains in November, plough it under in the middle of January and replant the land to a quick maturing catch crop early in February.

Inoculating and fertilising the green manure crop.

Generally speaking the tropical or sub-tropical agriculturist would seem able to lay his hand to a wide range of leguminous crops suitable for green manuring. Occasionally the one which would otherwise be most suitable may fail to form root-nodules on the soil in question. Where this applies, artificial inoculation of the soil or the seed by means of special cultures or by the use of soil containing the requisite bacteria should be resorted to, or if this is not practical the land in the first instance should be dressed with farm manure. In the writer's experience the legumes likely to be chosen will generally find a limited supply of the necessary bacteria in most tropical soils and the reproduction of these micro-organisms can usually be greatly stimulated by the addition of animal manure to the land.

Referring once more to Southern Rhodesia, officers of the Native Development Department have reclaimed worn out, granite sand, native gardens incapable of yielding more than one bag (203 lb.) of maize an acre, by the following means. The first year five to eight tons of farm manure is applied and maize is grown yielding four to seven bags an acre. The second year Sunn hemp is planted and on the residue of the farm manure makes an excellent growth five to seven feet in height with an abundance of nodules on the roots. This crop is ploughed under as a green manure, adding a wealth of humus and nitrogen to the soil, and thereby in two seasons rendering the land in a fit state for continued cropping under a suitable rotation.

More fertile soils will call for less drastic remedies, but often it will be found profitable to fertilise the green manure crop with phosphates and possibly potash as well. In this connection it is probable that where phosphates are primarily needed the use of rock phosphate on the green manure may be more remunerative than the application of high grade superphosphate (usually more expensive) direct to the major or succeeding crop.

Space will not permit of a more lengthy discussion of the many other aspects of green manuring and cover cropping which might be touched upon. Suffice it to say that in the writer's opinion the fringe of this most important matter has barely been touched upon in the research investigations thus far carried out, and the subject still provides a wide and most interesting field for scientific enquiry.

THE DR. MORRIS BIRD.

The Food Habits of Tyrannus Dominicensis Vorax in Barbados.

R. W. E. TUCKER, M.A., B.Ed.

THIS bird which is known in Barbados as the Dr. Morris Bird, rain bird, grey king bird, butcher bird, monkey bird or piperee is reputed to have been introduced into Barbados by Dr. D. Morris as a factor in the control of insect pests. The date of introduction does not appear to be on record, but Colonel Fielden in *The Ibis* 1889 records it as being established as an all round resident in Barbados in 1888.

Doubts have from time to time arisen as to the economic value of this bird, and by 1927 it had been decided that instead of being beneficial, the bird was noxious and should be destroyed.

This conclusion was reached because of the observed facts that the bird fed on wild honey bees, and on various native wasps which were thereby greatly reduced in numbers, and because it was suspected of preying on the beneficial parasite *Tiphia paralella*, which was alleged to be diminishing in numbers.

Investigations were therefore started by the writer to establish the food habits of this bird. Planters were circularised and asked to shoot Dr. Morris birds in the morning and to send them in to the Department the same day. Speedy dissection was found to be necessary because the birds did not keep fresh for long, and because their digestive action rapidly destroyed the identity of most insects.

Altogether 100 birds were received during a period of one year, and their crops removed and contents thereof examined. In only a few cases were empty crops found; usually, the birds were fully fed, and must be voracious feeders from the manner in which the crops were invariably crammed. Evidently if a suitable source of food was found, such as a wasp nest or a field infested with *Diaprepes*, the bird would feed until it could hold no more; crops were frequently found packed with one species of insect only.

The range in diet was found to be fairly wide, and the tastes of the birds catholic. In very few cases were insects entirely absent from the crops examined, and insects undoubtedly form the staple article of diet; wild fruits and berries, however, are freely eaten and in some cases formed the sole articles of diet; grain or leguminous seeds were never found. Next in order of frequency as an article of diet came young lizards and frogs, the former apparently predominating; altogether, from 100 birds, ten such complete or fragmentary remains were obtained. In two cases the remains of Chitons (*Molluscs*) were found, showing that occasionally even the sea-shore is visited for food, whilst in another case the bird's crop was packed entirely with spiders.

The proportion in which the principal articles of food were present in the contents of an average crop is as follows. Insects 3.25, seeds 2.1, lizards, &c., .1. These figures refer to individual specimens and in the case of insects, to identifiable remains only; if allowance is made for the large amount of unrecognisable insect remains, then an average of four insects, 2.1 fruits, and .1 lizards gives a normal crop content. When one takes into account the fact that many of the wild fruits were the size of a small olive, and that several specimens of a large locust (one of which would distend the crop to capacity) are included in the insects it can be seen that the above average is fairly reasonable and corresponds well with an average of six adult *Diaprepes* (cane root borer beetle) which formed the most consistent full meal noted.

An analysis of the identifiable food contents is as follows :—

Out of 100 birds dissected, 50 contained seeds or fruits and vegetable matter of some kind; those that could be identified were palm fruits, cordia bush berries and possibly tomato seeds; those that could not be traced were numerous small purple grape like berries and some small red coated berries. A few crops were found to contain palm fruits only, or purple grapes only, and some contained 15-20 *Cordia interrupta* berries, mixed with insect remains.

Seven of the 100 birds contained lizard and frog remains, a total of ten individuals being recognisable; in two cases there was no other food present in the crop.

The majority of birds contained insect remains, though as stated a few contained vegetable or animal food only. Naturally many of the insects were mere unrecognisable fragments; others could be referred to their particular orders but not named, and a few could be identified with certainty.

The results of the analysis of the 100 birds is as follows :—

Orthoptera.

Gryllus assimilis.—Seven specimens (from two birds). *Schistocerca pallens*; a large locust found in cane fields: (nine specimens were found in eight birds).

Odonata.

Ischnura rambusi.—One specimen. *Orthemis sulphurata*, three specimens: the remains of 25 other unidentifiable dragon or pond flies were found.

Hemiptera.

The remains of 26 unidentifiable Hemiptera were found.

Lepidoptera.

The remains of three moths and six butterflies were recorded, as well as three lepidopterous larvae.

Coleoptera.

Metamasius sericeus	66 specimens.
Diaprepes abbreviatus	40 specimens.
Myochrous armatus.	1 specimen.
Ligyrus tumulosus	1 specimen.
Cycloneda sanguinea	5 specimens.
Dynastid beetle	1 specimen.
Carabid beetle	1 adult and 14 larvae.

In addition 22 unidentifiable beetles (four being probably Chrysomelids) were found, and fragments of five larvae which appeared to be coleopterous.

Hymenoptera.

Odynerus grenadensis	3 specimens.
Henicospilus purgatus	1 specimen.
Tiphia paralella	1 specimen.
Polistes annularis	1 specimen.
Dielis dorsata	1 specimen.

In addition 35 *Vespidae* were found, ten *Formicidae*, eight *Apidae* (probably *Apis mellifera*), three *Xylocopidae* and ten hymenopterous remains that could not be classed.

Diptera.

The remains of eight dipterous insects were recognised. Owing to the absence of conspicuous chitinous parts which could withstand digestive action it was seldom that the remains of *Diptera* could be identified as such, save by detached wings.

Araneae.

Seven *Argiopidae* and one *Lycosid* (in the crop of one bird).

The foregoing list shows that on the whole, the rôle of these birds would appear to be beneficial in that there is no doubt that they feed largely on the root borer beetle *Diaprepes* and on the cane weevil *Metamasius*. The latter, which occurs practically all the year round in the cane fields, was found in quite 50 per cent. of the crops opened. *Diaprepes* on the other hand, was only found in the crops of ten birds, shot at the end and beginning only, of the period of emergence of *Diaprepes* adults. Had specimens of *Tyrannus* been available throughout the months of maximum beetle emergence (July and August) they would no doubt have been found crammed with *Diaprepes* as were those shot at the end periods as stated.

In addition, they destroy other noxious *Coleoptera*, *Hemiptera*, *Orthoptera* and a few *Diptera* and *Lepidoptera*.

On the other hand, their destruction of *Hymenoptera*, and young lizards would not appear to be beneficial. There seems to be no doubt but that wild bees and wasps have been largely reduced in numbers through the activities of *Tyrannus* but whether the wasps themselves exerted any check on the insect pests of the Island cannot at present be determined. If they did not, then their loss is of no consequence. The effect of the destruction of a few lizards and frogs, and of *Odonata* is relatively negligible.

The destruction of really beneficial insects appears to be purely fortuitous, such insects being taken by chance only. The total number of beneficial insects destroyed by 100 birds amounted to five *Cycloneda sanguinea* (Coccinellid), one *Henicospilus purgatus* (Ichneumon), one *Dielis dorsata*, which is a hymenopterous parasite of *Ligyrus tumulosus*, the black hardback and one *Tiphia paralella*, which is a hymenopterous parasite of the brown hardback *Phytalus smithi* a pest of sugar-cane.

Although it is quite possible that more than one *Tiphia* may have been present, but unrecognisable in the 100 crops examined, there could not have been many as special search was made for this insect and every loose hymenopterous wing carefully examined.

There does not therefore seem to be any evidence that the bird destroys *Tiphia paralella*, or any other parasite or beneficial insect, in any numbers, nor is the destruction of wasps of any proven detriment. The destruction of bees might be serious if the establishment of bee keeping were contemplated as a local industry; it should always be possible in such cases, however, to safeguard the hives and surrounding homing area from any persistent attacks on the part of Dr. Morris birds.

On the other hand, to offset these possible drawbacks in the activities of the bird, there is considerable evidence to show that it feeds extensively on noxious insects, and its habit of feeding extensively on the cane root borer beetle, and on the cane stem weevil may well be a considerable asset when the numbers of both the above pests have been reduced—as it is hoped to reduce them—by the control measures now in operation.

Therefore, although with such a voracious feeder there are bound to be items on the debit side of its record, there would appear to be sufficient balance on the credit side at present to justify the unharmed existence of *Tyrannus dominicensis vorax* in Barbados.

The proviso 'at present' is inserted because there is always the possibility that the control of cane pests may, by diminishing some of its main sources of food, divert the bird's attention to less desirable quarters, such for instance as the parasites of cane pests which it is hoped to introduce into Barbados later on. Its activities therefore in relation to feeding on insects will remain under observation.

A gratuitous specimen copy of *Tropical Agriculture* will be sent, post free, to any member of an agricultural society or to any other individual interested in tropical development on application to the Editor, *Tropical Agriculture*, The Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

TUNG OIL.

[*The information contained in the article appearing below has been extracted from a paper by Dr. L. A. Jordan, of the Research Association of British Paint, Colour and Varnish Manufacturers, which was published in Vol. XII, No. 107 of the Journal of the Oil and Colour Chemists Association.*]

Introductory.

TUNG OIL is an essential raw material of present-day varnish manufacture, and in fact its unique properties render it indispensable for certain types of varnish. Until comparatively recently, China has satisfied the world's demand for tung oil, and will, it is considered, continue to remain the chief source for some years to come. The oil is derived from two species of *Aleurites*, *Fordii* and *montana*, of which the former is the chief source. It was Wilson, a naturalist in western China, who in 1915, after a study of the species of *Aleurites*, solved the question as to the true origin of tung oil. *A. Fordii* has its habitat chiefly in western and central China, whilst *A. montana* is found more to the south. Tung oil, also termed China wood oil, was known outside China about 1760. It was first introduced into the United States in 1896, into Germany in 1897, and soon afterwards into England. Little notice of it was taken commercially in England until after the outbreak of War, when special water-resisting varnishes were required for aeroplane work. Thereafter, on the recommendation of the Raw Materials Committee of the Imperial Institute, growing experiments (Wilson having stated that he considered the trees could be grown in South Africa, East Africa, Australia, Algeria, and Morocco) were started in India, Ceylon, Malaya, Burma, Kenya, Tanganyika, Hong-Kong, and South Africa.

Natural habitat and growth of tree.

In China the tung oil trees, with reference principally to *A. Fordii*, occur abundantly and grow luxuriantly mostly in a region between latitude 26° and 34°N., and in hilly country up to 2,500 feet in altitude, especially in the upper reaches of the Yangtze valley. *A. Fordii* favours the northern and *A. montana* the southern parts of the area, but there is no strongly marked division in the distribution of the species. They are ornamental trees and rapid growers producing fruit, from which the oil is extracted, in and after the third year—though it is safest to calculate on a first crop as from the fifth year. In China the trees generally grow 20 feet to 25 feet in height, with a trunk of about 10 inches in diameter. But individuals are said to attain 50 feet to 60 feet with a canopy 60 feet in diameter. The trees have a low branching habit and pruning is necessary to prevent a low straggling cover. The fruit is about the size and appearance of a russet apple and ripens in October. The blossoms are very sensitive to early spring frosts, and young trees, until established, are subject to frost.

Rainfall and Temperature.

A main consideration in the culture appears to be the absence of frost and a sufficient rainfall, which should not be less than 30 inches but preferably 50 or even 70 inches. The *A. montana* species requires rather more rainfall than *A. Fordii*. According to Wilson, in China the tree requires a minimum rainfall of 70 cm. and he states that the tree luxuriates at Ichang where the rainfall averages 75 cm. most of which falls in April, July and August.

Also at Ichang the climate is rather one of extremes. The summer is tropical, the shade temperature ranging from 90° to 110°F. The winter is generally cold with much snow though the temperature seldom falls as low as 28°F.

Soil.

Tung oil has been tried on almost every type of soil, and has been found to grow on practically any soil which is slightly acid with plenty of moisture but still well drained. Apparently the ideal soil is a sandy soil or sandy loam which is underlaid with clay three to eight feet down. This type of soil can be usually drained easily but remains fairly moist. This does not mean, however, that the tung oil tree cannot and is not being grown successfully on other types of soil. Tung oil trees in Florida have grown on land that ranges from almost pure white sand to heavy clay loam, with excellent growth and yields on all. The observations show that slightly acid soil, well drained but with plenty of moisture, is safe to use for tung oil. Alkaline earth is fatal to the growth of the tree.

Methods of Cultivation.

Propagation.

So far as is known, the principal method of reproducing the tung oil tree is by seed propagation, although it has been determined that the trees can be readily budded and grafted with tung oil seedlings as stock.

Planting.

In Florida the best time to plant is in middle February when the soil is warm and maximum growth can be expected. Great variation is found in germinating power, particularly if the seed is old, and the plants tend to come up irregularly. Some 60 days are usually required for germination, but seed has been known to lie in the ground three months before sprouting.

Single seeds (not the whole fruit) should be planted three or four inches deep and from eight to 12 inches apart in the nursery row. In heavy soils the seed should not be planted at a greater depth than two inches. Nursery rows should be not less than three feet apart to permit of ample cultivation between them.

In China, two seeds are planted in a dug over spot three to five feet in diameter, and the soil kept in loose condition. If both seeds germinate one is removed. Transplanting is not generally very successful. Under favourable conditions in China plants will make three feet growth in the first season.

Site of Nursery.

A well-drained but fairly moist location should be chosen. The moisture content of the soil, particularly during the spring dry season, is of prime importance, as, if the seedlings are supplied with adequate moisture during this time they will not suffer from a set-back in growth which would be caused by droughty conditions. At the same time, the soil should be well enough drained that no water will stand between the rows for any length of time during the summer rainy season, which has a scalding effect on the young seedlings.

Nursery Cultivation.

Regular shallow cultivation should be given throughout the growing season so that a good dust mulch is always present and the nursery free from weeds or grass at all times. Because of the shallow rooting habits of the plant, deep cultivation should be strictly avoided after the first few weeks.

Transplanting.

When the time comes to transplant trees from the nursery to the grove, the methods commonly used in transplanting fruit trees are employed. The work should be done whilst the trees are dormant, and care should be taken to prevent injury to the root system.

As with all plants, exposure to sun or wind should be avoided, and at no time should they be allowed to become dry. Trees should be planted at the same depth as they stood in the nursery row. Deep planting is highly injurious. When seedlings are transplanted they should be cut down to a stub 12 or 14 inches above the ground. When established, no further pruning of young trees seems to be needed other than cutting off the tip of the plants; this may be done to cause more lateral branching close to the ground. In this connection the question of the distance to plant out the trees presents itself.

Orchard Distances.

The best size ordinarily attained by tung oil trees in China is about 25 feet by 20 feet spread under ordinary circumstances. They are frequently found about 11 feet apart. Growing the trees under orchard conditions, it would seem that 20 feet each way would be sufficient space for the proper growth of the canopy. However, as it seems that the cultivated plantation trees in Florida bid fair to exceed in size the average Chinese tree, distances of 25 feet by 25 feet, 25 feet by 30 feet or even 30 feet by 30 feet are suggested.

It has been suggested that trees should be planted in parallel rows, 12½ feet between trees in the row, and 30 feet between the rows. After the seventh year alternate trees should be removed which will leave 25 feet between two trees in the same row and each tree will be 32½ feet diagonally removed from its nearest neighbour in adjacent rows. It is calculated that the extra yield of fruit before the alternate trees are removed is sufficient to justify this practice. This arrangement finally bears 60 trees per acre.

Fertilisers.

The fertiliser needs of the tree have not been fully determined except to prove that young trees respond quickly to light applications of nitrate of soda or of Peruvian guano up to 1 lb. per tree. Cultivation between the trees by leguminous cover crops is recommended to keep the soil rich and moist.

Harvesting.

In China it is usual to knock the fruits off the trees before they are perfectly ripe. The husks are then removed by parching the fruit in iron pans over a fire or by collecting the fruit in heaps and allowing fermentation to take place to loosen the husks. Alternatively the fruits may be harvested at leisure after having fallen to the ground as they do not deteriorate through lying on the ground for a few weeks, and they are not eaten by cattle because of the disagreeable taste. The seed proper, after being removed from the husk, can be stored in any dry place for an indefinite period. However, if the seed is to be used for planting it should only be removed from the husk immediately before planting, and should not be carried over from one season to another. Seeds should be planted during the winter following the autumn in which they drop from the trees.

Yields and Plantation Costs.

Chinese trees yield from one to five bushels of fruit per season according to their age. The kernels form approximately half of the weight of the fruit and contain 58.3 per cent. of oil by analysis, the usual yield in practice being 40 per cent. A tree should yield its maximum crop in the ninth or tenth year and may be expected to have a useful life of about 30 years.

Little information is available on costs, but experience shows that $200 per acre is a safe figure to cover the cost of planting and carrying plantations with the necessary cultivation and fertilisation for a period of five years. Of this sum, $50 is allowed for the cost of land and cleaning. Up to the fifth year there would be no income worth speaking of but it is estimated that five year old trees would yield $100; rising gradually to $200 at ten years of age.

American Production.

As has been said, the world was dependent on China for the oil. The United States, the post-War consumption of which went up by leaps and bounds, were the first to realise the position and to take steps to obviate a total reliance on one source of supply and country. In 1914 the U.S.A. imported 61 per cent. of the total Chinese exports, in 1918, 77 per cent., and in 1925, 80 per cent. The American consumption is now 40,000 tons per annum. The oil is used to a considerable extent for domestic purposes in China, and the increasing world demand will encroach more and more on the stocks required for home use, which will mean that they will only be parted with at

an increased price. The methods of collection and extraction of the oil in China are crude and wasteful, yet the crop is regarded as a most profitable one by the Chinese.

It was these considerations which led the Americans, very soon after the War, to take up the question, added to the fact that they were reluctant to depend for their supplies on a foreign country. They began to study the possibilities of establishing a domestic industry and with a period of high prices in 1923 brought matters to a head, by forming the American Tung Oil Corporation. Its object was primarily to demonstrate what could be done with tung oil trees in the hope, which has been fulfilled, of encouraging farmers to cultivate the tree on a large scale upon a commercial basis.

Judged from the manner in which this work is developing over a very wide area in the southern United States, and also in Hawaii and the American Pacific Islands, it has become evident that the farmers have responded to the efforts of the Corporation. In 1923 all the information available in America was that a few tung oil trees had been successfully grown here and there in various parts of the southern United States, the oldest of these trees being about 14 or 15 years at that time. The Corporation acquired land adjacent to the Agricultural Experimental Station of the University of Florida, and the first seedlings were planted in 1924. By 1926, 2,500 acres had been planted up, representing about 200,000 trees. Distribution of one-year plants raised in nursery centres is made on very favourable terms to *bona fide* farmers. In the autumn of 1926 the Corporation had half a million seedlings in the nurseries available for distribution. The Corporation is assisted by the U.S. Department of Commerce, and everything is being done to stimulate the independent planting of the tung oil trees. Seed is now being sold from the nurseries to large landholders, and several hundred pounds of seed were shipped in 1927 to New Zealand, Jamaica, the Virgin Islands, the Philippines, and to England for Colonial purposes. In the Report for 1928 the area under tung oil trees amounted to 4,000 acres, whilst another 1,000 acres was projected in Florida during 1929.

Experiments have been made as to the best machinery for crushing the seed, 30,000 lb. of seed being experimented upon in 1928. In January, 1929, the first large-scale tung oil mill came into operation, capable of expressing about 50 gallons of oil per hour; this marking the commencement of activities on a commercial scale. As yet but a small percentage of the trees grown are old enough to produce fruit; it is considered, however, that in a few years a considerable supply should become available. It is estimated that an area of 100,000 acres would be required to supply the present American demand. The quality of the American oil is said to be better than the Chinese and freer from impurities.

Empire Production.

Turning now to the activities in this direction in the British Empire, it is apparent that they fall far short of the American. Prior to 1927 they were almost negligible. It has been stated that experiments were started in various Colonies in 1917, though the amount of available seed was small. Kenya had a record planting at 5,500 feet in 1922, seed from the trees being sent to the Imperial Institute in 1927. India carried out experiments at the Forest Research Institute at Dehra Dun. In 1924 trees of *A. Fordii* were fruiting at six years old but the seed germinated badly. The work, however, was still in an experimental stage.

The last two years have witnessed a real movement. It was in 1927 that the Research Association of British Paint, Colour, and Varnish Manufacturers took the matter up when considerable interest and enthusiasm on the subject was stimulated in many parts of the Empire by Dr. Jordan's first pamphlet. The Research Association then took the step of purchasing 700 lb. of selected seed of *A. Fordii* of the 1927 American crop and distributed it to privately owned farms and estates, government agricultural stations, and forest officers over the widest possible area. The general manager of the American Tung Oil Corporation rendered invaluable help in this matter, not only with seed but also with advice; "for the American view is that beyond a certain point they must ultimately look to British Empire production to augment their own supplies." The distribution of the seed by the Research Association was effected with the help and advice of Sir William Furse, Director of the Imperial Institute, and Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew, who heartily co-operated.

The seed was sent to middle and East and South Africa, India (Nilgiris, Malwa plateau, C.I., Bihar and Orissa, Bengal and Assam, the latter province being regarded as the most promising), Malaya, Ceylon, and Burma, where *A. montana* is indigenous. Seven tea estates have taken up the matter in Assam. All of them report approximately 50 per cent. germination. One estate reports trees averaging four feet in four months after transplanting: three reported six feet trees as the rate of growth from seed in one season.

Cyprus is experimenting with the seed, and work is being carried out in the West Indies, Palestine, Australia and New Zealand. Reports as to progress are insisted upon from all recipients of seed; so far those received are mostly favourable. As far as Africa is concerned, tung oil plants of the 1927 seed are now being watched everywhere from Kenya to the Cape—in Nyasaland, Tanganyika, the Rhodesias, Transvaal, Natal, Cape Province, and in Nigeria.

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

SUGAR CONFERENCE.

II. Factory Information.—*Concluded.*

[*Published below are summaries of some of the papers, containing cane factory data, that were read at the Third Conference, held at Sourabaya, Java, of the International Society of Sugar Cane Technologists.*]

The Decomposition of the Reducing Sugars in an Alkaline Medium during the Sugar Manufacture. —Dr. K. Douwes Dekker. *Bulletin No.* 10.

Decomposition of reducing sugars occurs in the factory when the juice becomes alkaline. Three changes take place:

1. Decrease in the Fehling reducing power.
2. Increase in the colour.
3. Increase in the total acidity and therefore increase in the quantity of soluble calcium salts. This is probably the most important.

When either glucose, fructose or mannose is placed in an alkaline medium, a mutual conversion takes place and a mixture of these three sugars is formed. De Bruyn and van Ekenstein found also pseudo-fructose and glutose.

This interconversion of simple sugars in the presence of alkali has been explained by Nef, by assuming intermediate enolformation on the basis of selective hydration and dehydration. The velocity of the reaction and the nature of the products obtained are influenced by external factors:—temperature of the solution, time and concentration of alkali. Acids also may be formed whose calcium salts are very soluble. Different authors state that both glucose and fructose are weak acids and probably form salts in alkaline solution. Proof of this is shown by the fact that a saturated solution of calcium hydroxide has a pH value of 12.6 which is lowered to pH 10.6 when one mol. of glucose per litre is added to it. According to Nef these salts tend to split off MOH and to form unsaturated methylene-derivatives. The methylene derivatives are converted into ortho-osones, which form saccharinic acid just as pyrinic aldehyde gives rise to lactic acid. Another point of view is that the ortho-osones are not formed from the methylene derivatives but from the enediols. Two other reactions may take place which yield a more or less coloured tar-like susbtance and a polysaccharide compound. The tar may be considered as a polymerisation product of the unsaturated methylene derivatives. As regards the pollysaccharide formation, Nef has shown that the Fehling's reducing power of a hot slightly alkaline solution of glucose can be increased by treating it with an acid, the optical rotation simultaneously decreasing.

In the actual process of manufacturing cane sugar, importance must be attached to the presence of glutose in the various products. Nef has placed glutose in his reaction scheme as a mixture of 3-Ketoses which have a normal Fehling's reducing power, are fermentable and are not oxidized by an alkaline iodine solution.

By the action of lead hydroxide on fructose, de Bruyn and van Ekenstein obtained a product which they called glutose but whose properties are quite different from those described by Nef. It has half the Fehling's reducing power, is unfermentable and is oxidized by an alkaline iodine solution. It undergoes conversion yielding not hexoses, but acids. Spoehr and Wilbur obtained a similar product by the action of sodium phosphate on invert sugar. Glutose is absent in fresh cane-juice since after fermentation, Fehling's solution yields but a slight precipitate. Assuming glutose to have half the normal reducing power, the amount of this sugar found accumulated in final molasses varies from five to 12 per cent. and this must be borne in mind when comparing theories of the exhaustion of molasses with determinations of the solubility of sucrose in invert sugar solutions. Again, since glutose is unfermentable its presence is of importance in the manufacture of alcohol from molasses.

Acids also are formed during the process of sugar manufacture, especially when an increase in temperature and alkalinity occurs. It is possible however, to retard their formation by the addition of a negative catalyst - sulphur dioxide which also decreases the colour of the juice. Preliminary work at the Experimental Station shows that the addition of sodium sulphite to a solution of glucose in sodium hydroxide will decrease the tendency towards acid formation. One molecule of glucose yields one molecule of saccharinic acid but two molecules of lactic acid. Hence the acidity is reduced by half if saccharinic acid is the only product. At a given temperature and alkalinity, a concentrated solution of glucose yields relatively less acid than a dilute one. Vnuk separated gluco-saccharinic acid from beet molasses and studied its properties. It exhibits negative rotation while its lactone shows a positive rotation about one and a half times that of sucrose. In the determination of sucrose in molasses by the Clerget method and using lead subacetate as clarifying agent, the salt will be converted into the lactone and the sucrose figure obtained will be too low. It has been calculated that with 0.5 per cent. lactone in the molasses, this discrepancy will amount to 50 per cent. The change of salts to lactone can be followed by means of the polariscope.

As far as is known no attempts has been made to demonstrate the presence of saccharinic acid in cane molasses.

Van der Linden attempted to find out the extent of decomposition of reducing sugars under factory conditions and concluded that the greatest change is the mutual inter-conversion. Java factory control for 1912 states that the average amount of decompositon from raw juice to syrup for defecation factories is 21.5 per cent. This figure varies, however, with the method of clarification.

The Experiment Station at Pasoeroean, has decided to attempt to obtain definite and reliable data on this problem.

The three following changes will be measured under as varying conditions as possible.

1. The disappearance of the total amount of reducing sugar as measured by Fehling's test.
2. The change from altoses to ketoses measured by means of alkaline iodine solution.
3. The formation of acids and the increase in colour as measured by the decrease in alkalinity of the solution. The conditions to be varied are :—Temperature, alkalinity, composition of the reducing sugars, concentration of the reducing sugars, and addition of other substances.

Preliminary experiments have been carried out and some results are given.

J. G. D.

* * *

Bagasse as a Fuel. AUGUSTE ESNOUF. *Bulletin* No. 9.

The calculations in this bulletin are based on figures obtained from the analysis of Mauritius bagasse. A very thorough mathematical treatment is given, setting out methods for determining air necessary for combustion, products of combustion, thermal capacity of flue gases, &c., and the effect of using preheated air on the temperature of the furnace.

J. G. D.

* * *

Results obtained with Baryta-Alumina Clarification with Cane Juice Products.—J. H. HALDANE AND NOEL DEERR. *Bulletin* No. 12.

The accepted method for the determination of sugar by means of the polarimeter, calls for the clarification of the material with lead salts, usually the acetate.

This method introduces known and recognized errors which are :

1. The volume of the precipitate formed by the lead salts is neglected.
2. The direct reading is variable, dependent upon the quantity of lead employed. This effect is most noticeable in the presence of larger quantities of levulose.
3. In the Clerget determination as usually carried out the direct and invert readings are made in different media, the direct slightly alkaline and the invert strongly acid. The effect of this is to give a varying rotation to the invert sugars originally present.

The use of dry lead acetate (Horne's method) aims at eliminating the first. The second and third may be removed by double neutral polarization (Saillard-Gilles and Jackson).

One of the authors has worked out a scheme which introduces strict double neutral polarization and at the same time corrects for precipitate volume error.

The method follows the routine due to Coates and Shen and clarification for the direct reading is affected by the precipitation within the solution of equivalent quantities of barium hydroxide and aluminium sulphate. The inversion is made with sulphuric acid and the clarification affected with the same substances.

The method was tried out in five factories in the past season on mixed juice, syrup and waste molasses, and the following figures show the results obtained by it together with those obtained by the conventional dry lead method.

	Lead Clarification.		Baryta Clarification.	
	Per cent. Pol.	Per cent. Suc.	Per cent. Pol.	Per cent. Suc.
Mixed Juice ..	13.31	13.49	13.24	13.40
Syrup ..	46.46	47.11	46.19	46.84
Molasses ..	34.18	35.93	32.83	35.18

The order of the different methods and the differences between the different methods is very uniform.

A few determinations on waste molasses were made with invertase and they agreed within experimental error with those obtained with acid inversion.

J. D. G.

CORRESPONDENCE.

Past College Students.

Imperial College of Tropical Agriculture,
14, Trinity Square,
London, E.C.3., England.
1st January, 1930.

THE EDITOR,
"TROPICAL AGRICULTURE."
TRINIDAD.

Sir,

An endeavour is being made to compile a register of Past Students of the Imperial College of Tropical Agriculture with a record of their achievements and of the appointments they hold, or have held. With this object in view a questionnaire was addressed to all Past Students whose whereabouts could be ascertained last year. The response has not been altogether satisfactory, owing, no doubt, to the fact that Students or Past Students are now so widely scattered over the face of the globe.

May I, therefore, avail myself of your columns to invite those who have received the questionnaire but have not yet returned it, to do so at their earliest convenience, and those who have not received it to communicate with me so that copies may be sent to them ?

It is proposed to publish a Register of Past Students when an adequate number of replies has been received. Consequently I hope that you will assist my efforts to get into touch with Past Students of the College.

Yours faithfully,
(Sgd.) ALGERNON ASPINALL,
Secretary.

ARTIFICIAL DRYING OF BEET.*

THE exceptional interest aroused by the recent developments in the drying of the sugar beet should merit the attention of the readers of *Tropical Agriculture* and a short description of the methods employed may not be out of place.

The drying of the beet has occupied the attention of chemists and engineers during the last 180 years, starting with Marggraf who, in 1747, discovered sucrose in beet and actually dried the beet before extracting the sugar.

If the beet could be economically dried without the destruction of the sugar, the following are the more important advantages that would accrue to the beet industry :—

(1) The dried cossettes (*i.e.*, beet slices) could be preserved for several months without appreciable loss, thus enabling the process of extraction to be extended over a long period, indeed over the whole year.

(2) A factory which could work all the year round would not need, for the same annual sugar output, to be nearly as large as one which functioned for three months only.

(3) There would be a saving in carriage on the dessicated cossettes as compared with beets in the fresh state, and there would be a possibility of opening up new areas for beet growing by provision of drying stations.

(4) Less volume of water would be required for the extraction and purification of the sugar, and effluent would be less noxious and more easily disposed of.

Recent work since the war by de Vecchis in Italy and Owen and co-workers at Oxford have gone far to prove the possibility of the economic drying and extraction of sugar from beet, and the dessication process is being developed and adopted not only in England and Italy but also in France, Belgium, Czecho Slovakia and in Russia.

During the development of the Oxford Process for the dessication of beet and subsequent production of sugar, many great practical difficulties have been encountered. As regards the actual drying of the beet, these difficulties have now been overcome and beet is being dried at the Eynsham Factory, near Oxford, at the rate of 200 tons per day, with a fuel consumption of approximately 8 to 8.5 per cent. of coal (of 13,000 B.T.U.) on the weight of the washed beet. Working on a large production, say of 500 tons of beet per day, this coal consumption could be reduced to below eight per cent.

The Oxford engineers have developed a continuous perforated metal belt Drier, hot air being blown through a 7 inch to 8 inch layer of cossettes. The Drier is divided into three compartments of different sizes to correspond with the correct velocity of the air suited to the particular stage of drying. The actual temperature of the cossettes need never exceed 180°F, and the destruction and inversion of sucrose is negligible. For the 1928 campaign the glucose ratio only increased on drying from 0.7 to 1.0, representing 0.38 per cent. inversion on the beet. The moisture content of the beet is reduced from 75 per cent. to five to six per cent. in approximately 45 minutes. The dried cossettes which contain 65 per cent. of sugar are white and quite hard, and can be stored for many months without showing appreciable moisture change.

The actual cost of drying beet in England varies with the tonnage handled, but lies between approximately 4*s*. and 5*s*. per ton beet.

The extraction of the sugar from the dried cossettes has presented many unexpected difficulties, principally in the diffusion. The dried cossettes swell very considerably when placed in water and this has necessitated a specially designed diffusion battery. The cossettes yield a thick juice of approximately 40° Brix, containing less nitrogenous impurities than ordinary diffusion juice obtained from fresh beet, owing to the coagulation of the albumenoids which remain in the pulp, thus enhancing its feeding value. Owing to the density of this juice the usual carbonation process cannot generally be applied and the juice is merely limed to pH 7.8, clarified by centrifugal action and then filtered with or without carbon. The filtration has proved somewhat slow in practice but means have been devised to improve this stage of the process, while for the production of raw sugar filtration may be eliminated altogether. The quality of the sugar boiled depends partly on the treatment of the juice, but no difficulty has been experienced in obtaining a sugar equal to an ordinary cane plantation white, and if decolorising carbon is employed the sugar approaches a refined type. The recovery of the sugar and the quantity of molasses produced are normal.

During the 1928 Season 14,000 tons of beet were dried at Eynsham and this year this quantity should be exceeded. The figures actually obtained at Eynsham during these operations indicate a substantial saving in the total costs of producing sugar compared with the ordinary diffusion process in Great Britain. Were 50,000 tons of beet dried in the season, these savings should amount to 30 per cent. allowing for interest charges, and for 100,000 tons the cost of producing one ton of white sugar (inclusive, except for the cost of the beet), amounts to £6 14*s*. 0*d*. approximately.

The Oxford Process can be well adapted to the ordinary diffusion factories by the erection of driers and storage facilities for the dried cossettes, whereby the factories can extract sugar throughout the year and can extend the area of their beet supplies. By the erection of drying stations beet can be grown in new areas hitherto beyond the range of a diffusion factory.

In those European countries where the price of beet sugar is abnormally low as at present, it has been found more profitable to sell the dried cossettes as cattle food rather than to extract the sugar.

* Contributed to *Tropical Agriculture*.

It is doubtful whether the dessication process could be economically adapted to the production of cane sugar owing to the expense of the fuel required for drying the shredded cane and furthermore, the bagasse after diffusion would still require to be passed through mills in order to reduce the water content to a figure permitting of its combustion. The general experience with the Naudet Process has proved that some additional fuel (*i.e.* oil) has been necessary in order to supplement the bagasse, and this disadvantage has weighed heavily against the process. It will be recollected that cane drying experiments both in Madagascar, Porto Rico, and in Cuba were abandoned, though sugar was actually extracted in a Marseilles Refinery from dried powdered Madagascar cane.

Investigations at the Institute of Agricultural Engineering, Oxford, have also been extended to the drying of other crops, such as grasses and potatoes during that part of the year in which the driers would be otherwise idle. An excellent cattle food has been prepared on a large scale from dried potatoes. It has been found possible to dry grasses and accelerate the production of hay by blowing hot air into the stack. This may well prove of inestimable advantage under English weather conditions, and the Oxford methods should find application to some extent in the Tropics.

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(3) Preliminary Report of an Investigation into the Artificial Drying of Crops in the Stack, 1926.

(4) Report on an Investigation into the Desiccation of Sugar Beet and the Extraction of Sugar, 1927.

(5) Report on the Development and Costs of the Oxford Process for the production of Sugar from Sugar Beet, 1929.—(*Oxford Clarendon Press.*)

COTTON IN 1928-29.

In 1927-28 the feature of the Consumption statistics was that both American and Egyptian showed consumption largely in excess of the crop. That is again true to a modified extent of American this season, but not of Egyptian, where, owing to a much larger crop, a considerable addition has been made to the Carryover.

As regards American the total is over 15,000,000 bales for the third season in succession, but this year the round figure is just exceeded and no more. The first half of the season showed a substantial increase on the very low figure to which the second half of the previous season fell, but the improvement was hardly maintained in the second half. The total of 15,076,000 running bales (excluding linters) compares with the 1928 crop figure of 14,297,000 running bales.

Looking backwards it is interesting to note that the second half of the season 1926-27 reached a total of 8,356,000 bales, while the first half of season 1927-28 was 8,228,000, making a total for the period of twelve months of 16,584,000 bales. That represented the record world's consumption, and was due to the very low price of American as the result of the record crop of 1926.

One question which has perturbed the cotton world during the past season is why the price has persistently refused to rise at least as high as in the previous season. The answers usually given in the trade are (1) that during the past season the world shifted over to a substantial extent from American to Indian cotton; and (2) the increasing use of outside growths of all kinds in place of American. The Federation statistics, however, do not bear out these arguments, as, although the world's consumption of Indian cotton in 1928-29 was well above that of 1927-28, it was still below that of the previous four seasons; in other words, the consumption of Indian cotton during the past season has merely returned to something like normal. As to the consumption of Outside Growths, Egyptian shows no change to speak of, while the total consumption of Sundries has barely maintained the high level of 1927-28. It must, of course, be remembered that the statistics of Sundries are very much confused by the figures in those countries where the bale weight is small. Thus Russia's consumption of Sundries (chiefly her own cotton, which is in bales of small weight) has now gone back to pre-war figures, which means that it is well above anything in recent years; whereas her consumption of American has fallen sharply during the second half of last season. This is in line with the rapid recovery of the Russian crop, which in 1928 was back to about the same figure as 1914.

The relative position of the United Kingdom in the World's Consumption shows no improvement at all; in fact, our consumption of American for the season is the lowest since 1923-24. The figures of Egyptian showed very little improvement to set off against this, though there is a fair increase in the use of Indian; but the most disconcerting feature is the heavy drop in the consumption of Sundries, which incidentally includes all Empire cotton except Indian; and the result is that our total consumption of all kinds of cotton is again the lowest since 1923.

The World's Carryover of American Cotton shows a further fall for the season and makes the total the lowest since July, 1925. It will not stand much further depletion. The Egyptian, on the other hand, shows an increase of fully a million kantars, but is still below the record of July, 1927. —(J. A. Todd in the *Empire Cotton Growing Review*, Vol. VII, No. 1).

THE CHEMISTS' EXHIBITION.

Members of the drug trade are invited by the Organisers to visit the 37th Chemists' Exhibition which will be housed from 26th to 30th May, in the Hall of The Royal Horticultural Society, Westminster, London, S.W. near the Houses of Parliament and Westminster Abbey. Admission can be obtained on presentation of trade card.

THE AMANI INSTITUTE.

THE first* Report of the Director on the Amani Agricultural Research Station has been published. It contains a statement of the present Director's activities since his appointment in March, 1927, of the research programme contemplated and of the progress that has been achieved since the Station has been reorganised. With the exception of the Director, the Entomologist and the Superintendent of plantations, the rest of the Staff did not assume their duties until 1928, the last appointment being made in October of that year.

It will be remembered that Amani was taken over from the Germans in 1916. The first English Director was appointed in 1920. On his resignation in 1923, the Station was left in the sole custody of the Head Gardener until it was taken over by the present Director. Its area is some 750 acres, of which about a third remains under original forest while the rest is described in the report as a "well stocked arboretum" with scarcely any land suitable for arable cultivation. The main buildings occupy the crown of a series of converging ridges at a height of 3,000 feet, and the plantations extend down the slopes to the Sigi River at 1,300 feet and ascend a neighbouring summit to a height of 3,700 feet.

The Director, on his arrival, made a survey of the Station's resources and then visited Kenya, Tanganyika, Zanzibar, Northern Rhodesia, Nyasaland, and Uganda, in order to become acquainted with their agricultural conditions and to determine the lines on which research might most profitably be directed. It was during this tour that the consent of the Governor of Tanganyika was obtained to add to the Station the neighbouring Kwamkoro Coffee Estate which had previously formed part of the Prince Albrecht Plantations. The area of this estate is some 8,000 acres, of which approximately 1,000 acres had been cleared from heavy forest and planted with coffee. Kwamkoro provides what Amani so conspicuously lacks, considerable areas of gentle slopes and a certain amount of level ground with fairly good soil capable of use for agricultural experimentation.

Most of the year under review (1928-29) was given up to the reconstructions of some of the buildings and to provide necessary equipment for the different sections. Although the roads and plantations were in good order and the laboratories and other buildings well cared for, the interiors of a number of the dwelling houses were considerably dilapidated by damp and termite infestation. A road four miles long was constructed through exceedingly heavy forest between the Kwamkoro Estate and Amani which were formerly connected by a bridle path. The difficulties of transport were a heavy and constant brake on the progress of the work of reconstruction. The re-opening of a narrow gauge railway from the main line to the boundary of the Research Station should, however, help to solve these difficulties. The scarcity of native labour was also a constant source of anxiety and it has been more responsible than even the difficulties of transport, for the length of time that has been taken for the reconstruction of the Station. The population in the vicinity is scanty, and the climate of Amani is exceedingly unpopular with the inhabitants of the lower levels. The importation of men of the hardier tribes of Central Tanganyika is a necessity, but is difficult to arrange without the services of the professional recruiter, and is in any case expensive. It is hoped that improvement in the arrangements for food supply and efforts to provide congenial living conditions will lead to the increase of the resident native population.

The Research programme which has been laid down is an extensive one, and comprises amongst other things a projected survey of the geological structure, soil, climate, fauna and vegetation of East Africa, coffee problems, problems connected with the conservation and restoration of soil fertility, plant breeding, insecticides, insect migration, virus diseases, pests and diseases, the adaptation and distribution of crop plant varieties in East Africa, the recording of pests and diseases and of the agencies of natural control, the introduction of new plants of new varieties (the desirability of doing this at one centre is recommended), and the coordination of measures to exclude pests and diseases. A start has been made on the lines of research enumerated.

G. G.

* East African Agricultural Research Station, Amani. First Annual Report of the Director for the period 1st April, 1928, to 31st March, 1929.

CEYLON COCONUT INDUSTRY.

FRESH coconuts, copra, desiccated coconut, and coir yarn show a decrease in production, while coconut oil, poonac, and fibre show an increase over the figures for 1927. Prices remained steady for part of the year but showed a general decline towards the end of 1928.

A few enterprising coconut planters have experimented with new methods of cultivation, particularly the use of green manures and mulching, but adoption of green manuring has not been general. A movement towards the use of both green and artificial manures has taken place among villagers in the Southern Province.

Investigation of the Eulophid parasite of the coconut caterpillar (*Nephantes serinopa*) has been carried out by the Entomological Division and the Plant Pest Inspector of the North-western Division. It was proved that the parasite attacked the caterpillar during the pupal stage of the latter. Experiments carried out showed that the use of cyanogas in the control of black beetle and red weevil was not practicable. The Acting Mycologist has continued his investigation of coconut root disease and has performed inoculations of palms with fungi isolated from cases of disease. As far as coconuts in the field are concerned, it may still be said that the incidence of disease of fungus origin is very small and that losses from disease are of little consequence.—(*Amalgamated Annual General Report for* 1928, Ceylon.)

TROPICAL WORLD NOTES.

Kenya.

According to the 1928 Colonial Report*, the rainfall during the year was generally under average and as a consequence crops suffered in some districts, the yield of coffee being much reduced. Labour difficulties in 1925 and 1926 arrested progress in the planting of new coffee areas, but conditions in this respect have greatly improved and in 1928 the highest annual increase yet recorded was planted. The dreaded pest of coffee-growing countries—the Coffee Bean Borer (*Stephanodores*)—was identified for the first time on a number of plantations.

Except in the Nyanza Province, where yields were high, the maize crop was below average, and in parts of the Nakuru District it largely failed on account of drought. The wheat crop also suffered in like manner. The average wheat yield for the Colony is eight bushels per acre which is extremely low, but this is accounted for by sowings made on the poorer soils, drought in some areas, heavy losses due to "rust," and destruction by birds. Rules and standards were promulgated under the Agricultural Produce Export Ordinance for "export" wheat and, through the enterprise of the Kenya Farmers' Association, a large addition has been made to the storage capacity for wheat to be stocked at their mill.

There was a remarkable increase in the area under sisal. Much skill and attention are given to the organisation of this industry and the marketing of the product, not only by the companies owning sisal estates but by its representative organisation, the "Sisal Growers' Association," and success has been achieved particularly in reducing costs of production.

Owing to shortage of rain generally, a smaller surplus of crops was available for sale from the Native Reserves, and in some areas a shortage of food existed. Grazing in the pastoral areas was poor and resulted in low condition of stock generally and a reduced output of produce and animals fit for market.

Notwithstanding the adverse seasons, development on the whole continued at a satisfactory rate. There has been a general awakening to the importance of maintaining soil fertility. Progress in the development of "mixed farming" is slow. In so far as "mixed farming" implies growing a wider range of crops, it is now being realized that a rotation is for several reasons, very necessary, but the farmer who is struggling to become established is not disposed in the earlier stages to grow crops the produce of which is not marketable at a profit, however valuable these crops may be as "restorers" and "improvers" of soil fertility. Again, in so far as "mixed farming" means the inclusion of stock in the operations, the impediments are the incidence of disease in the most highly productive areas, and the low productive capacity of the cattle, whether for beef or milk.

* No. 1463.

Mechanical cultivation has been encouraged by the rebate given by Government to users of kerosene for agricultural purposes. The great advantages derived from this efficient and expeditious form of performing agricultural operations is unfortunately to some extent discounted by its present comparatively high cost. In the light of experience, there is a tendency more fully to combine the use of tractors and draught-oxen in the major farming operations. This combination is likely to prove not only efficient but the most economical.

During the year, arrangements were made for the organisation of an East African Meteorological Service under the direction of the Statistician to the Governors' Conference.

A system of forecasting crops was also introduced and reports were published in respect of the months September to December. Monthly estimates of their crops were submitted by 178 crop correspondents and the Agricultural Department was thus enabled to inaugurate successfully this valuable service.

* * *

Curaçao.

Curaçao is an island in the Dutch West Indies, lying some 40 miles from the north coast of Venezuela. It is some 40 miles long from north-west to south-east, with an average width of ten miles and an area of 212 square miles. The surface is generally flat, but in the south-west there are hills attaining the elevation of some 1,200 feet. The shores are in places deeply indented, forming several natural harbours, the chief of which is that of St. Anna on the south-west coast. Willemstad is the only town of the island and the seat of the Government. The population of the whole island is estimated at some 33,000, that of Willemstad being about 9,000. Willemstad has a strong resemblance to a Dutch town, many houses being built in the style of those of Amsterdam, and the narrow channels separating it from its western suburb of Overzidje, and the waters of the Waigat, which intersect it, are reminiscent of the canals of the Netherlands. The negroes of the island speak a curious dialect called *Papaimento*, composed of a mixture of Spanish, Dutch, English and native words. For the tropics, the climate is unusually dry, the average rainfall being only some 16 inches, and generally not too unhealthy. The island cannot be described as particularly fertile, much of the soil being arid, but sugar, aloes, tobacco and *divi-divi*, oranges, &c., are produced in the more fertile parts. Commerce is mainly with the United States, and there is a large carrying trade with Venezuela. The principal articles of export are salt, *divi-divi*, phosphate of lime, aloes, orange peel (destined to become the foundation of the well-known liqueur "Curaçao"), goat skins and straw hats. The cost of living is generally high.—(*The Colonizer*, Vol. XXXIV, No. 408.)

Zanzibar.

A set of statistical tables relating to the production, trade, &c., of Zanzibar since its assumption by Great Britain in 1890 according to the *Geographical Journal* (Vol. LXXIV, No. 2) show a remarkable fluctuation from year to year. The total value of both imports and exports has largely increased since the protectorate was assumed, but a part at least of the increase has no doubt been due to a rise in prices since the war, while a recent decline from the maximum (reached in 1920) appears also to be, in part at least, a result of a parallel fall in prices. A considerable proportion of the trade is a transit trade with the opposite mainland, and apart from this the principal participants are British India, the United Kingdom, the Dutch East Indies, Italy, and the United States. During the past five years this country's share in the import trade has slightly increased, while that in exports from the protectorate has declined. Italy's share in the latter shows a marked increase since 1926, as does also that of the Dutch East Indies. The United Kingdom continues to enjoy the largest share of the piece-goods imports, while that of British India has declined and that of Japan has risen. The production of cloves is notoriously subject to marked fluctuations in response to good or bad seasons, and though the total value has risen four or five fold, since 1893, the greater part of the rise has, it seems, been caused by the increase in price. Five-sixths of the world's production of cloves now comes from the protectorate. The export to the United Kingdom has lately declined, and that to the United States and the Dutch East Indies has risen. The quantity as well as value of copra exported has risen considerably, most going to France and Italy. The tonnage of ocean-going vessels entered during 1928 was 1,388,000, of which nearly half was British; for some years after the war the proportion of British vessels was higher. The native population was 216,797 in 1924, Arabs and British Indians being both under 20,000.

The total exports* of the Protectorate for 1928 have shown a decrease in value of 10.4 per cent. compared with 1927. The year under review was marked by a sharp rise in clove prices, the range being Rs. 11 to Rs. 29 per fasila. Clove exports, however, as shown by the following figures revealed a substantial decrease:

		Tons 1,000s.	*Value* £ 000s.
1927	..	12.9	820
1928	..	7.9	651

Important measures affecting the clove industry and the inci ence of taxation were brought into operation udring the year. In July a cash *ad valorem* duty on cloves, collected immediately prior to shipment, was substituted for the duty in kind. At the same time the rate of duty was reduced from 25 per cent. to 20 per cent. and the system of the payment of a bonus to plantation owners by way of rebate of duty was abolished. In August, with the object of retaining an important market for Zanzibar cloves, the Government brought into effect a system of drawbacks of duty in respect of cloves used in the manufacture of clove oil vanillin.

In January Mr. V. H. Kirkham, Director of Agriculture, visited Madagascar and obtained valuable first-hand information regarding the progress of clove production and various economic factors connected with the clove industry in that country.

* * *

Southern Rhodesia.

According to the *Rhodesia Agricultural Journal*, Vol. XXVI, No. 11—the exports of citrus fruits from Southern Rhodesia in 1928 amounted to 25 per cent. of the total quantity of citrus fruit shipped by growers from all the provinces of the South African Union. It is expected that shipments from Southern Rhodesia this season will amount to close on 200,000 cases. The great bulk of the fruit is sent to the United Kingdom, where the public is beginning to relish oranges in the summer. Small regular shipments have also been made this season to the Sudan, India, Ceylon and Marseilles, where it is hoped to establish paying markets. A present handicap is the long railway haul entailed by exporting fruit *via* Capetown. and for this reason 30,487 cases were shipped *via* Beira with successful results.

Citrus growers in Southern Rhodesia have adopted the principle of co-operation wholeheartedly, and the success attained is a striking example of the benefits of working together for the common good.

* * *

Ecuador.

From recent reports it appears that the country's cocoa production for the first half of last year has not been up to average. Total deliveries since 1st January were only 23,179,700 Spanish lb.* as compared with 31,129,800 lb. in the same period of 1928. In previous years the cocoa crop had attained to nearly one million quintals but it decreased by as much as 50 per cent. in 1927. This staple product represents 49 per cent. of the country's total exports. The progressively dwindling cocoa crop and lower price paid for it have, it is believed been brought about largely through the prevalence of "witch-broom" disease which seems to have visited the very warm lowlands and valleys situated near the coast and especially those adjacent to Guayaquil where a large number of Ecuador's cocoa plantations, estimated at over 5,000 with over sixty million trees are to be found.—(*The Economist*, Vol. CIX, No. 4485.)

* 1928 Colonial Report No. 1434.

* One Quintal equals 100 Spanish lb. or 101·47 English lb.

ENTOMOLOGICAL NOTES.

Compiled by the College Department of Entomology.

Rice Straw as Packing Material.

Rice straw is used extensively in the Orient as a packing material, but as several Lepidopterous pests hibernate as mature larvae or pupate in the bored stems, this material may be instrumental in the importation of pests into Hawaii and California. During a visit to Japan, *Chilo simplex*, Butl., *Schoenobius bipunctifer*, Wlk., *Sesamia* (*Nonagria*) *uniformis*, Ddgn., and *Naranga diffusa*, Wlk., were found in the hollow stems of rice plants. These moths are important pests of rice in Japan and other oriental countries, and will attack other grasses and even sugar-cane on occasion. The Noctuid, *N. diffusa*, is not a stem-borer, and its presence in this situation indicates that other species of this group, many of which are important pests, might use rice, barley or wheat straw as a convenient shelter for hibernation or pupation. The Hawaiian Government has placed an embargo on rice straw since the discovery of *C. simplex* in the rice-fields of Hawaii. It is not considered that the fumigation in Japan of goods packed in rice straw would obviate the danger, since the hibernating larvae are very resistant to insecticidal gases, the fumigating equipment is insufficient, no satisfactory plan has been put forward for the supervision of the fumigation, and the fumigation of goods packed in places remote from the ports where the fumigating plants operate cannot be undertaken. Therefore, the use of sawdust or wood shavings is suggested for packing instead of rice straw, although their cost is somewhat higher and greater care in making up the packages to avoid breakage is necessary.—(*The Review of Applied Entomology*, Vol. XVII, Ser. A, Part 12.)

* * *

The Coconut Scale in Fiji.

Since the importation into Fiji in 1928 of five species of Coccinellids from Trinidad to control the coconut scale, *Aspidiotus destructor*, Sign., there is abundant evidence that at least one species, *Cryptognatha nodiceps*, Mshl., has become well established. Observations in various localities in May, 1929, show that, wherever the predator has spread, the scale has been almost exterminated, and the condition of the trees is already greatly improved. The Coccinellid has evidently flown in some cases at least a mile in search of food, and has cleared up an infestation ten miles from one point of liberation. Brief inspections on other Islands have indicated that equally satisfactory results can be expected on all of them. The beetle increases very rapidly, as the life-cycle requires about 3½ weeks, and a female lays about 120 eggs a month. Two of the other introduced Coccinellids seem to have become established, but are not an important factor in the control of the Coccid.—(*The Review of Applied Entomology*, Vol. XVII, Ser. A, Part 12.)

Fruit Flies.

The Plant Quarantine and Control Administration of the United States Department of Agriculture issues, from time to time, information as to pests collected from imported plants and plant products. The following notes are taken from their Annual Letter of Information, No. 41, covering the period 1st January to 31st December, 1928.

"The following fruit flies were intercepted: West Indian fruit fly (*Anastrepha fraterculus*) in guava from Cuba, mango from Cuba, Haiti, and Jamaica, grape from Peru, and sapodilla from Trinidad; Mexican fruit fly (*Anastrepha ludens*) in avocado, guava, mamey, mango, orange, pomegranate, and sapote from Mexico; *Anastrepha serpentina* in nispero from Curaçao; *Anastrepha* sp. in loquat and Surinam cherry from Bermuda, *Eugenia malaccensis* from Costa Rica, mango from Cuba, Haiti, Honduras, Jamaica, and Mexico, mamey from Mexico, chico from Salvador; melon fly (*Bactrocera cucurbitae*) in cucumber and string bean from Hawaii; Mediterranean fruit fly (*Ceratitis capitata*) in peach from France, pear from Greece, coffee berry, mango, papaya from Hawaii, locust pod, sour orange, and tangerine from Italy, loquat from the Madeira Islands, orange and pomegranate from Spain, and miscellaneous interceptions (hosts unknown) from Italy and the Madeira Islands; *Ceratitis* sp. in orange from Italy and prickly pear from the Madeira Islands; olive fly (*Dacus oleae*) in olive from Greece, Italy, Portugal and Spain; trypetid in quince from Greece, string bean and tomato from Hawaii, and Mandarin from India."

Interceptions made on the "Graf Zeppelin."

"Upon the arrival of the *Graf Zeppelin* from Germany at the United States Navy air station, Lakehurst, New Jersey, on 15th October, 1928, inspectors of the administration made the customary examination of the passengers' baggage, &c., in co-operation with representatives of the Customs Service. No plants or plant products were found in the cargo or in passengers' baggage. However, three bouquets of flowers—roses, carnations, and chrysanthemums—were located in the passengers' quarters, all of which were abandoned for destruction. A careful examination of these flowers resulted in the finding of seven species of insects and two plant diseases, as follows:—Chrysanthemum—*Aphis* sp., *Myzus persicae*, Coccinae, *Lecanium* sp., *Thrips tabaci pulla*, eggs and cocoons of a Noctuid; carnation—leaf spot *Heterosporium echinulatum*; rose—*Tritogenaphis sonchi*, *Typhlocyba rosae*, and leaf and stem disease *Sphaceloma rosarum*.

While these insects and plant diseases may not represent pests new to the United States, they attract interest in that they were among the interceptions made on the occasion of the first lighter-than-air commercial trans-Atlantic voyage."

JAVA AND ITS SUGAR INDUSTRY.

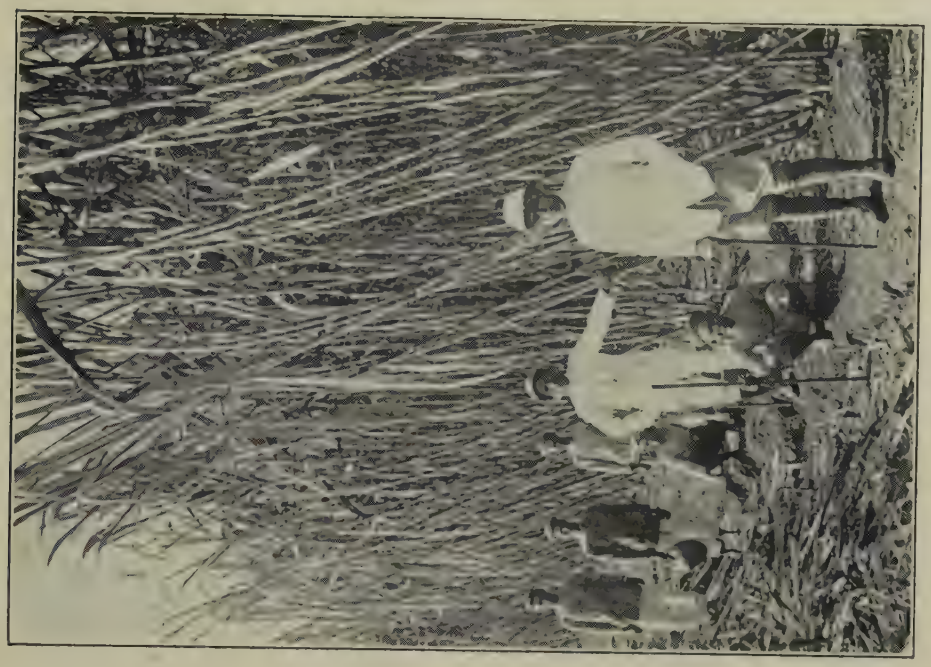

FIG. 7.—*A typical field of P.O.J. 2878 in Java.*

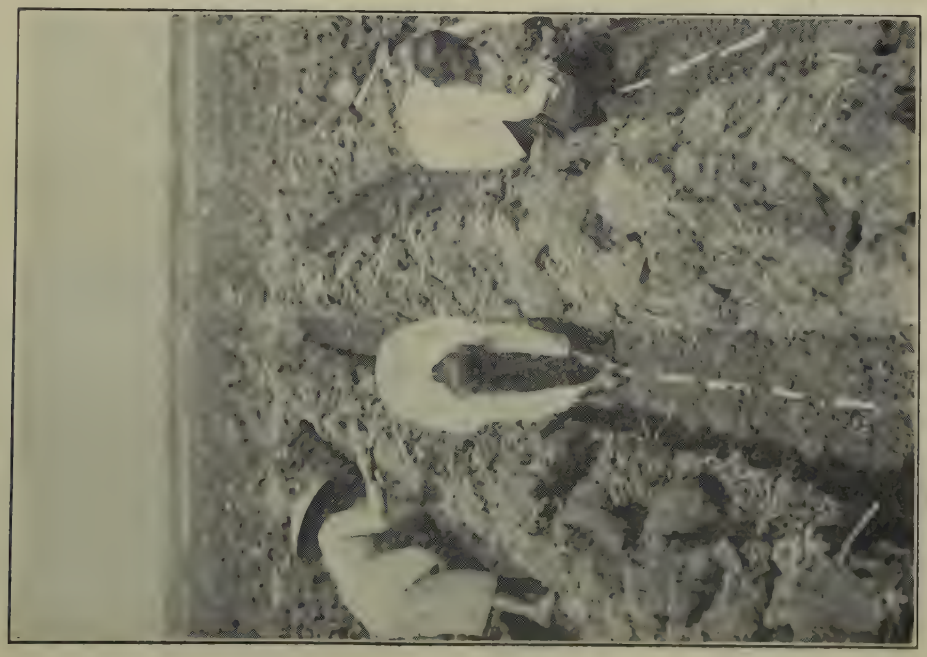

FIG. 6.—*Planting.*

JAVA AND ITS SUGAR INDUSTRY.

FIG. 8.—*The cane is dug out with a crowbar, topped, cleaned of roots and trash, then tied in bundles.*

FIG. 9.—*Transport of cane to the factory is effected principally by means of narrow-gauge railways using animal power or locomotives.*

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Ground-nut Cultivation in India.

The groundnut crop in recent years has assumed an economic importance of the first magnitude in some Indian Provinces. The area of 5,321,000 acres sown in 1928 was nearly four times as large as that in 1918-19. It has more than trebled in Madras during the same period, while the increase in Bombay is over 500 per cent. In Madras, which carries nearly 63 per cent. of the total reported acreage, varietal and cultural experiments are in progress on a special farm at Palakuppam. The introduction of early varieties which do not require irrigation has made the groundnut the most important khariff oil-seed grown in the Bombay Presidency. Twenty years ago its cultivation was practically unknown in Upper Gujarat, Khandesh, and Dharwar, whereas now approximately 400,000 acres are devoted to it. As the export trade demands a high-grade product, the local department is making special efforts to insure the cultivation of pure varieties.

Groundnut has also invaded the cotton tracks of the Central Provinces. It is grown there either in rotation with, or in place of, cotton, and regular markets for the nuts are developing. Burma is another province where groundnut has made great headway; within twenty years the area under cultivation has increased to 500,000 acres. In varietal tests at Allanmyo, the Imperial Spanish stood first in yield and the small Japanese in oil content. There is a great future for these short-season erect types, as they do well in light sandy soils. Groundnut has become so popular on the poor soils of Chota Nagpur that questions relating to the marketing of the product have arisen in some areas. The early erect Kanke No. 17 is the variety favoured. Were it not for the damage done to the crop by pigs and wild animals, it would be equally popular in South Behar where large yields of this oil-seed are obtained by manuring with gypsum. In Mysore, where the area under cultivation has increased from 77,000 to 250,000 acres in ten years, bunch and spreading types are crossed with a view to aggregating strains which, while retaining the special characteristics of the former, will have the vigour of the latter—(*Industrial and Engineering Chemistry, News Edition*, Vol. VII, No. 16.)

* * *

Vitamins in Tomatoes.

Experiments recently conducted at the United States Bureau of Chemistry and Soils have shown that tomatoes which are allowed to stay on the plant until they are ripe are superior in vitamin content and food value to those picked green and then treated with ethylene gas to give the fruit the colour characteristic of the ripe fruit. The ethylene treatment, however, apparently has no harmful effect on the vitamins already present in the green fruit. (*Indus. Engin. Chem.* Nov. 1929.)

The Vitamin Content of Grass Seeds in relationship to Manures.

Two similar plots of ground in the same field were sown with grass seed. One was manured with dung from pigs which were fed on barley meal, "middlings," and "Vitameale," a preparation containing "Bemax" residue, which has a high vitamin-B content. The other plot was manured with artificial manure, *i.e.*, basic slag, kainit, sulphate of ammonia. The grasses were cut and the seeds separated by hand. The chemical analyses of the seeds were practically the same. The seeds of the grasses were tested on rats for their vitamin-B content, 25 per cent. of the seeds being added to a standard B deficiency diet. In the preventative test three rats on "dung" seed grew 134 g., as against 68 g. grown by the three rats on "artificial" seed. In the curative test the rats, having been on B deficiency diet, were put on 25 per cent. "dung" seed and rapidly recovered. The rats put on "artificial" seed became so ill after three days that they had to be put on "dung" seed, when they immediately recovered. The conclusions drawn were that the plant can absorb vitamin-B from the soil, and the vitamin-B content of the plants depends on the amount of vitamin in the soil.—(*Chem. and Ind. Journ.* Vol. 48, No. 52.)

* * *

The Biological Decomposition of Plant Materials.

The decomposition of plant tissues results from the metabolic activities of a large microflora, and in extent depends on the availability of the plant constituents to the organisms. Cellulose, in the presence of sufficient nitrogen, is rapidly and extensively utilised as a source of energy. The hemicelluloses, of which there is usually a much lower percentage, are also removed, and particularly so in the opening stages. Lignin has been shown by many workers to be unavailable, forming a physical barrier to the organism in its search for food. Its quantity and distribution therefore have a great influence on the probability of decomposition. The hemicelluloses, being encrusting substances, have to be removed in part before the cellulose can be attacked, and further, as some groups in the hemicellulose molecule are probably more easily available to the micro-organisms than is cellulose, they play, together with the small quantity of sugars and starch, an important part in the provision of easily obtainable energy in the early stages. The way is thereby paved for a general attack on the cellulose. There is evidence of the formation of furfuraldehyde-yielding groups during the decomposition, in part masking the real loss of hemicelluloses. Cellulose is not improbably the source of these transitionally formed substances. Pectin does not appear to be removed unless the medium becomes acid—an abnormal condition. —(*Chem. and Ind. Journ.* Vol. XLVIII, No. 52.)

REVIEWS.

Nelson's West Indian Arithmetics.

(*Teachers Books.*—Introductory and Book II, pp. 96, price 2*s.* Books I and III, pp. 97, price 2*s.* Book IV, pp. 128, price 2*s.* 6*d.* Book V, pp. 160, price 2*s.* 9*d.* Book VI, pp. 288, price 3*s.* 6*d.* *Pupils Books.*—Introductory and Book I, pp. 48, price 10*d.* Books II and III, pp. 48, price 11*d.* Book IV, pp. 64, price 1*s.* 1*d.* Book V, pp. 80, price 1*s.* 3*d.* Book VI, pp. 144, price 1*s.* 9*d.* *Thomas Nelson & Sons, Ltd.*)

This series is very definitely practical, attention being confined to that which the child will need and can learn. Now the West Indian Islands have few characteristics in common and the situation is complicated by the use of English, Canadian and American units of account, measurement and weight. It is greatly to the credit of Captain Cutteridge that he has succeeded not only in meeting the peculiar needs of individual islands but also in combining them into an orderly and well arranged series. It is particularly gratifying to note that considerable attention is given to agricultural problems. The exercises, which are drawn from actual estate accounts, are calculated not only to give the scholar facility in dealing with practical agricultural problems but also to convey to him a great deal of information concerning the agricultural industries not only of his country but also of islands other than his own. An admirable series.

C. Y. S.

* * *

Bean Culture.

E. V. Hardenburg. *The Macmillan Co.*, Price 12*s.* 6*d.* pp. 238.

The author's aim has been to produce a handbook, useful to the grower, student, and teacher, on the subject of beans grown as a marketable food crop, both on garden and field lines. The economics of the crop are dealt with, including its history, distribution, trend of production, cost and marketing. The various classes of Common Beans are described, also the different types and varieties, and indications are given of the relative value of the various types for special purposes.

General methods of planting are discussed, and reference is made to climatic and soil conditions suitable for the cultivation of the bean crop. Fungous and bacterial diseases are enumerated, and their control measures are described. Insect pests receive similar attention.

Useful information is given regarding marketing and the method of preparation of the produce for different purposes. Desirable characteristics in beans are described, and suggestions are made concerning improvement by plant selection.

D. B.

Text Book of Tropical Agriculture.

By Nicholls and Holland. (*MacMillan & Co., Ltd.*)

This book was originally written in 1892 and gained a prize offered by the Jamaica Government for the best Text Book of Tropical Agriculture specially adapted for the use of Colleges and Schools in that Colony. That it met a need is evident, for it has been in demand ever since, and has been reprinted a number of times, the last in 1920. The work of revising it has now been undertaken by Mr. Holland, Assistant in the Museums, Royal Botanic Gardens, Kew.

In a foreword by Dr. Hill, the present Director of Kew (the original volume was dedicated to Sir Joseph Hooker, who was then Director), it is stated that the original text has been retained as far as possible, but it may be doubted if this was wise policy, if indeed, there was any chance of producing an up-to-date Text Book on such a basis. The first portion of the Book, headed the Elements of Agriculture, stands in some need of revision, and this refers particularly perhaps to the chapters on Soil and Tillage. The chapters on Drainage and Irrigation are somewhat inadequate, and no reference is made to the important subject of alkalinity.

After this criticism, it is pleasanter to turn to Part II, dealing with Agricultural Products, which has been immensely amplified and which is well illustrated. It is a pity that a number of the illustrations, such as those dealing with maize, lucerne, sorghum and groundnuts have been taken from American text-books, because these do not show the crops under tropical conditions, and the wisdom of introducing so many pictures of machinery without adequate description may be questioned, but the illustrations from the Kew collection are in the main excellent, and there is a wealth of information available about tropical crops.

The difference between peasant farming, and the capitalistic production of exportable commodities, and the wide diversity both of crops and the conditions under which they are grown, make it an almost impossible task to treat Tropical Agriculture in a single volume, even if all reference to livestock, and to insect and plant diseases is omitted, as in the present volume. There is no text book on Temperate Agriculture; even Stephens' Book of the Farm deals only with a small region more or less known to the author. To attempt to compress the subject within the limits of a single volume either implies generalising to a point where the information given is deprived of its value, or else confining oneself to a particular class of farmer, in this case the 'planter', in a particular area, largely in this case, Jamaica. Within these limits the book has its uses.

R. C. W.

COLLEGE NEWS.

Mr. F. L. Engledow, M.A., a Governor of the College, has been elected to the Drapers' Professorship of Agriculture, School of Agriculture, Cambridge, in succession to the late Professor T. B. Wood.

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Mr. E. E. Cheesman, Professor of Botany and Genetics, Mr. H. A. Ballou, Commissioner of Agriculture and Mr. G. A. Jones, Assistant Commissioner of Agriculture, sailed for St. Vincent by s.s. *Lady Drake* on 12th February.

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Mr. E. J. Wortley, Director of Agriculture, Trinidad and Tobago, and Mr. F. G. Grant, Managing Director of Messrs. T. Geddes Grant, Ltd., President of the Trinidad Chamber of Commerce, and Member of the Legislative Council have been co-opted as Governors of the Imperial College of Tropical Agriculture.

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Mr. H. W. Simmonds, Government Entomologist, Fiji, who had been carrying out experiments at the College on the biological control by means of thrips of *Clidemia hirta*, a serious weed in Fiji, sailed for that Colony by s.s. *Carare* on 8th February. He took with him ten cages containing colonies of thrips (*Liothrips Urichi*), collected during his stay in Trinidad and also a number of specimens of the plant believed to be *Clidemia hirta*, on which these thrips were discovered.

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A party of prominent members of the Canadian Manufacturers' Association visited the College on 6th February. The delegation was headed by Mr. R. J. Hutchings of Calgary, and particular attention was paid to the Low Temperature Research Station and to the Sugar Factory.

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Amongst recent visitors to the College were Lord and Lady Baden-Powell of Gilwell, Mr. G. Foulkes-Jones, Governor of University College of Wales, and Mrs. Foulkes-Jones; Mr. F. E. Holloway, President of the Mutual Brokers Montreal, Ltd., Canada; Mr. J. A. McBride, General Manager of the Fruit Importers, Ltd., Canada; Mr. B. Grant, Correspondent of the *Daily Mirror*, England, and Mrs. Grant; Mr. R. W. Miller, Director of Agriculture, Barbados; Mr. E. A. McCallan, Director of Agriculture, Bermuda; The Hon. A. E. Collens, Superintendent of Agriculture, Leeward Islands; Mr. F. G. Harcourt, Superintendent of Agriculture, Dominica; Dr. A. E. S. McIntosh, Geneticist, Department of Agriculture, Barbados; Mr. F. Bennet, Deputy Director of Agriculture, British Guiana; the Hon. J. S. Dash, Director of Agriculture, British Guiana.

COLONIAL APPOINTMENTS.

The following appointments have been made by the Secretary of State for the Colonies during the month of December, 1929:—

Mr. N. Humphrey, Agricultural Officer, Kenya.

Mr. L. R. Doughty, B.SC., Geneticist, Tanganyika Territory.

AGRICULTURAL EXCURSIONS.

SEVERAL field excursions were arranged during January and were attended by senior students and members of the Staff.

On 15th January a visit was made to Valsayn Coconut Estate, the property of Mr. E. A. Robinson, where an opportunity was afforded to inspect the methods of draining, round ridging and other aspects of coconut cultivation. Although the general condition of the trees on this plantation was excellent, one or two diseased trees were found, and on permission being granted to have these cut down, the cause of death, which in one case was Bud Rot, was in each instance discussed. Afterwards the extraction and preparation of copra were inspected.

On 22nd January, under the guidance of Professor Cheesman, a visit was paid to the College Banana Plots. The large collection of varieties from all over the world was inspected and the plan of campaign that is being conducted, with a view to raising seedling bananas immune or resistant to Panama Disease, was explained. Afterwards the Low Temperature Research Station was visited, where the most promising of these new varieties are being tested out in comparison with Gros Michel and subjected to ripening tests under controlled conditions. These experiments were described by Dr. L. P. McGuire. Dr. C. W. Wardlaw similarly detailed his inoculation experiments and investigations of Stem End Rot and Panama Disease.

On 3rd February an afternoon excursion was made to Spring Estate, Tamana. Mr. W. S. E. Barnardo, the proprietor, was good enough to describe the history of his grapefruit orchard and his experiences in cultivating this fruit under local conditions of high rainfall. The soil is somewhat on the heavy side and naturally therefore efficient drainage is a first essential. In spite of these precautions, however, several trees are showing signs of "Gummosis," as there had been a tendency to bud stocks too low in the past. An attempt to get round the effects of "mal de gomma" by inarching is being made and demonstrations of the methods employed were actually carried out by Mr. Barnardo. The method of packing and grading fruit and the question of standard crates and standardisation were also discussed. The trees in this plantation are all March seedless, budded on selected sour orange stocks.

On 5th February a visit was made to the Cotton Research Station of the Empire Cotton Growing Corporation. The work of the Genetics Department was ably explained by Dr. S. C. Harland who is dealing mainly with new world types of cotton and by Mr. J. B. Hutchinson who is working on the Asiatic cottons. Results of considerable genetic value are obviously being obtained, but in addition to the information gleaned on this important science, the agriculturists of the party were also interested in such practical aids as the "solar propagator" and the methods of bottle grafting employed.

G. E.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows (*c.i.f.* per cwt.):

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
29th December ..	8	4½	11	3
2nd January ..	8	4½	11	3
9th January ..	8	4½	11	3
16th January ..	7	9	11	3
23rd January ..	7	3	10	9
30th January ..	7	6	11	0
7th February ...	7	6	11	9

According to *C. Czarnikow, Ltd.*, general dullness and indifference on the part of buyers continue to be the predominating characteristics of sugar markets. These conditions are attributed to the apparent excess of supplies over requirements, and have lately been considerably accentuated by the state of suspense in which the Trade in the United Kingdom has been placed through the uncertainty of the fate of the Sugar Duties in the forthcoming Budget. A general disinclination to provide for distant future requirements has led to a steady decline in values, whilst considerable liquidation in the March position on the London Terminal Raw market (quoted at present at 6*s.* 2¼*d.* sellers) has also assisted in the downward movement. This weakness has exerted an influence which has become almost world-wide, inasmuch as this country is the largest buyer of sugar in the open market, and the depreciation in the value of the article has been felt not only by every British Colonial producer, but also by every other producer who is forced to depend on World markets for the disposal of a part or the whole of his production. The trend of markets appears now to be no longer regulated by the actual statistical prospects of sugar. World values have been allowed to drift to what may reasonably be regarded as unjustifiably low levels. Apart from the possible development of fresh features calculated to influence prices one way or the other, the course of markets during the next two or three months would appear to depend largely on the policy followed by producers. So far, holders for the most part have presented a firm attitude and have shown little inclination to market their produce at recent low levels, their ideas, particularly for new crops sugars, being much above the parities ruling in "free" markets.—(London, 16th January.)

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association:—

	American Mid.	*Egyptian F. G. F. Sakel.*	*Sea Island.*		
			Good.	*Extra fine.*	*Prices paid this Week.*
13th Dec.	9·47	14·25	25·00	38·00	12·00-34·25
20th Dec.	9·36	13·95	25·00	38·00	25·50
27th Dec.	9·51	14·20	25·00	38·00	—
3rd Jan.	9·53	14·30	25·00	38·00	26·00-28·00
10th Jan.	9·58	14·65	25·00	38·00	24·00-26·00
15th Jan.	9.56	14.45	—	—	—
7th Feb. (local)	8.60	—	25.00	38.00	—

There has been little change in the value of American cotton. Egyptian showed, however, a tendency to increase at the beginning of January. Although the business is generally slack the undertone remains reasonably steady. The latest statistical details from the New York cotton exchange service emphasise the lesser consumption of American cotton by Lancashire and the Continent in comparison with the increased use of such varieties as Peruvian, Brazilian, and East Indian.

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COCOA.—The cocoa market continues quiet but steady at unchanged prices. The fact that the Accra crop will be short has had a good effect and indications point to higher prices.—(*By courtesy of the Cocoa Planters' Association, Trinidad.*)

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COFFEE.—Sales per cwt. of Kenya coffee at 60*s.* to 72*s.* and of Costa Rica at 83*s.* to 111*s.* are recorded. Colombia had a fine crop last summer but has not sent this country very much so far. Kenya is extending its area; so is Uganda, and the culture of coffee is extending into Nyasaland. Jamaica is nominal at about 70*s.* to 75*s.*—(*Times Trade and Engineering Supplement,* 11th and 18th January.)

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RUBBER.—Quotations for Plantation Sheet have ranged as follows:—

31st December, 8*d.*; 8th January, $7\frac{5}{16}$*d.*; 15th January, $7\frac{3}{16}$*d.*; 22nd January, $7\frac{5}{16}$*d.*; 29th January, $7\frac{7}{16}$*d.*; 7th February, $7\frac{13}{16}$.

According to *Symington and Sinclair's*, after a slight improvement at the end of the year prices did not hold, buyers being reserved on easier advices from the East. The publication of the Malayan shipments, coupled with heavy increases in United Kingdom stocks, further depressed the market. The latest *American Questionnaire* figures were also of a rather depressing nature.